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MARYVALE AREA FLOODING MITIGATION PROJECT PHASE I FCD 93-34

PRE-DESIGN REPORT

VOLUME A: SECTIONS 1.0 THROUGH 10.0

Appendix I
Appendix II
Appendix III
Appendix IV
Appendix V

Coe & Van Loo Consultants, Inc.
4550 North 12th Street
Phoenix, Arizona 85014

MARYVALE AREA
FLOODING MITIGATION PROJECT
PHASE I
FCD 93-34

PRE-DESIGN REPORT

January 25, 1996

Prepared for:

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, AZ 85009

Prepared by:

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MARYVALE AREA FLOODING MITIGATION PROJECT
PHASE I - PRE-DESIGN REPORT

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1.0 INTRODUCTION

1.1 Scope

Coe & Van Loo Consultants, Inc., (CVL) has been contracted by the Flood Control District of Maricopa County (District) for Phase I of the Maryvale Area Flooding Mitigation Project. As defined by the "Scope of Work," Phase I, the pre-design phase, involves the preparation of a final pre-design report that will include a hydrology study, an engineering analysis, and a feasibility study for two flooding locations adjacent to the Grand Canal and within the City of Phoenix (Exhibit 1). Details of the project's tasks are outlined in the contract agreement "Scope of Work" (Scope).

1.2 Purpose

The purpose of this report is to document the results of the hydrologic analysis and alternatives investigation phases of this project, outline the decision-making process used to determine the final design recommendations, and present the final pre-design solutions for the identified flooding areas. Included in the report are preliminary cost estimates for the recommended design solutions.

1.3 Project Description

The two flooding locations named in the Scope were identified by the City of Phoenix (City) from known past flooding events. These two areas are located at; (1) 64th Drive and Sunset Drive (Area A) and, (2) 47th Drive and Crittenden Lane (Exhibit 2). The hydrologic modeling phase has confirmed that the 100-year flood event would significantly impact these two locations. A schematic drawing which identifies flooding locations as reported by the City is included in Appendix IV. In addition, flooding reports and discussions with city streets maintenance staff indicated that flooding has resulted from canal overflow following the breaching of the canal banks by local residents.

1.4 Project Summary

During the alternatives investigation phase, a general list of various mitigation possibilities was created. After some discussion and qualitative analysis, several of these possibilities were determined to have enough credibility to undergo further analysis. These alternatives, six for Area A and ten for Area B, and an order of magnitude cost estimate for each are included in Appendix III.

Three design alternatives for each area remained at the end of the alternatives investigation phase. The high costs of these alternatives led to the decision to derive some alternatives that would provide a lower level of protection for each location. A Floodprone Area Map (See Appendix IV), was created based on the assumption that the maximum flooding depth could not exceed either the adjacent top of bank elevations for the Grand Canal or the adjacent street to the west. This map clearly showed that Area A and Area B were severely impacted by localized flooding. It also identified an

additional flooding area, Area C, that lies directly west of Area B, between 55th Avenue and 57th Avenue. Area C was included in the subsequent design analysis. Revisions to the concept alternatives were made and, once again, costs were estimated. This development of alternatives into a reduced number of options resulted in a final recommended solution for each flooding location.

Finally, preliminary design plans and cost estimates were prepared for the recommended solutions. These plans include detention basin grading, existing storm drain extension, new storm drain construction, and drainage channel construction. The preliminary plans are presented in Appendix V with their respective preliminary cost estimates.

1.5 Project Execution

This project was divided into three major sub-tasks; existing condition modeling, alternatives investigation, and development of the recommended plan into pre-design plans presented in this Pre-Design Report. Reports for the Hydrologic Modeling and Alternatives Investigation stages of the project have been previously submitted and reviewed by the District. This report builds upon study information previously developed and submitted to the District.

2.0 PREVIOUS STUDIES AND REPORTS

The flooding in this area has been noted in several flood damage reports dating back to 1963. Principal flooding areas of interest to this study occur along the north side of the Grand Canal between 35th Avenue and 67th Avenue. Reports reviewed are summarized as follows:

(1) *Summary of Flood Control Program Report, 1963.*

This report documents two projects designed to mitigate flooding in the study area as follows:

(a) Maryvale - Glendale Drain was a proposed lined channel running from the Grand Canal 1/2 mile west of 67th Avenue westerly to the Agua Fria River.

(b) West Phoenix - Maryvale Drain was planned to run from 47th Avenue at the Grand Canal south to Thomas Road and thence southerly to the Salt River.

(2) *Flood-Damage Report on Storm and Flood of 16-17 August 1963, Glendale - Maryvale Area*

This report documents the storm and flood event of August 16 and 17, 1963. A maximum of 5.25 inches of rainfall was measured in Glendale over a 6-hour

period. This was reported to exceed a 100-year storm event. Water ponded against the railroad tracks adjacent to Grand Avenue and flooded many businesses along Grand Avenue from 27th Avenue west to U.S. Highway 60. Flow along Grand Avenue occurred in a southeasterly direction from Glendale Avenue. South of Grand Avenue, flooding occurred from 43rd Avenue to the New River. A break occurred in the north bank of the canal near Indian School Road and in the south bank at 43rd Avenue and 64th Drive. Several photographs document flooding within the study area, particularly in the area of the 6300 block north of the Grand Canal, near Sunset Drive, and at a canal breach just south of Indian School Road.

(3) *After Action Report - Flash Flood of July 23-24, 1992*

This report identifies that the Grand Canal was breached at the intersection of 45th Avenue. The report states that the residents in the area made the breach in order to drain water from the streets in the neighborhood.

(4) *Maryvale - Flooding History*

This District correspondence documents a history of flood events in the Maryvale area. In addition to the 1963 flood event, a September 22, 1966 flood event caused flood depths of 3 feet at 59th Avenue and Clarendon.

(5) *Stormwater Flooding Report, July 23 and 24, 1994*

This in-house report by the City of Phoenix documents the 1992 flood event which was reported to have resulted from rainfall in excess of the 100-year event. The rain gauge at Maryvale Municipal Golf Course recorded 3.78 inches in less than an eight hour period.

The report notes that two detention basins located at Indian School Road and 35th Avenue were filled and overflowed to the south. These basins were designed for a 50-year flood. In conclusion, the report notes that the most reasonable method of preventing flooding might be the purchase of a large number of houses and creation of a "greenbelt" park type detention basin.

(6) *Glendale - Peoria Area Drainage Master Plan, 1987*

This report addresses a widespread study area which extends from Camelback Road north to Pinnacle Peak Road and west from 43rd Avenue to the Agua Fria River. The study includes an analysis of several alternatives and includes recommendations for construction of an area wide storm drainage system.

3.0 HYDROLOGIC ANALYSIS

3.1 General

The hydrologic modeling phase of this project has included a review of detailed topographic mapping, field reconnaissance, evaluation of watershed flow paths and sub-basin boundaries, and development of watershed runoff parameters. The precipitation data for various frequency storm events was compiled using guidelines in the *Drainage Design Manual for Maricopa County, Arizona Volume I - Hydrology* (June 1992). All hydrologic parameters were compiled into an existing condition hydrologic rainfall-runoff model using the U.S. Army Corps of Engineers computer program HEC-1, Version 4.01 (HEC-1) (1991). This model was later adapted to model existing watershed conditions with the recommended plan in place.

The HEC-1 computer program was used to model the Maryvale Watershed, for the 2-year, 6-hour; 10-year, 6-hour; 50-year, 6-hour; 100-year, 6-hour; and 100-year, 24-hour storms. The September 1990, version of HEC-1 (as implemented by Dodson and Associates, Inc. in their 1991 version of ProHEC-1) was used in this study. The Clark Unit Hydrograph, the Green-Ampt Loss Rate, and the Normal Depth/Modified Puls Channel Routing options were used in the HEC-1 model for the Maryvale Watershed. The assumptions, procedures, and methodologies used to develop the HEC-1 data input sets are discussed in the following sections.

3.2 Description of Watershed

A majority of the study watershed has been urbanized with single and multi-family residential, commercial and industrial development. Details are shown on the Land Use Map, Plate 4 in Appendix I. Industrial properties are located predominantly along Grand Avenue while single family residences lie adjacent to the Grand Canal.

Grand Avenue and the adjacent railroad are elevated above natural grade and form a manmade barrier to the natural drainage paths. The natural drainage pattern is from the north and northeast to the south and southwest. Grand Avenue runs in a diagonal direction and any flood flows conveyed within Grand Avenue, south of Glendale Avenue, would occur in a northwest to southeast direction.

3.3 Drainage Area Boundaries

The study watershed encompasses approximately 8 square miles. The study area is located north of the Grand Canal, southwest of Grand Avenue and east of 67th Avenue (See Exhibit 1). The sub-basin boundaries were initially delineated using aerial maps from Kenney Aerial Mapping (March 1994). The initial delineations were then verified or modified based on field investigations. The sub-basin boundaries are illustrated on Plate 1 in Appendix I.

The sub-basins were delineated such that concentration points were provided at generalized locations due to the broad flow patterns and lack of a single point of flow

concentration. The sub-basin areas were limited to a maximum of 1.0 square mile; however, most of the sub-basins have areas much less than that. In general, sub-basin boundaries follow the street drainage patterns but give regard to the overall natural flow patterns.

In establishing the drainage area boundaries, it was assumed that Grand Avenue served as a drainage barrier to flows from the north. At Indian School Road and Grand Avenue the intersection flattens and the division of drainage boundaries was less distinct. Field review of this intersection indicated that initial flows, up to approximately 1 to 1-1/2 feet in depth, would flow southeast along Grand Avenue. In addition, two large detention basins, located north of Indian School Road on both sides of 35th Avenue, would intercept large flow volumes from north of Grand Avenue. It was therefore decided to assume that Grand Avenue would act as a drainage barrier along its entire length. Where major storm drains enter the study area, their flow capacity was included in the model.

3.4 Rainfall Parameters

3.4.1 Rainfall Distributions

The rainfall distributions that were used for the 6-hour storms were based on distributions documented in the District's *Hydrologic Design Manual* as implemented by the Maricopa County Unit Hydrograph Procedure 1 (MCUHP1). The SCS Type II distribution was used for the 24-hour storm.

3.4.2 Precipitation Data

The point precipitation values used in this study were obtained from isopluvial maps for Maricopa County published in the District's *Hydrologic Design Manual*. The point precipitation values are given in Table 1 in Appendix I. These values were calculated using the PREFRE program provided by the District. Aerial reduction factors were applied to the point precipitation using the JD card copier within HEC-1. These values were calculated as a part of the MCUHP1 program computations.

3.4.3 Computational Time Step Interval

The computational time step interval was chosen to be long enough such that the total storm was covered by the 300 time increments, and short enough that it was not longer than the shortest time of concentration (Tc). A time step interval of 5 minutes was chosen. With 300 time increments, the computations cover a period of 25 hours. This was sufficient to model both the 6-hour and 24-hour storms.

3.5 Physical Parameters

3.5.1 Unit Hydrograph Procedure

The majority of the watershed is urbanized with relatively flat slopes. Therefore, the site was modeled based on the Clark Unit Hydrograph as implemented in the MCUHP1 program.

3.5.2 Loss Rate Estimation

Precipitation loss rates were computed using the Green-Ampt Infiltration Equation option in HEC-1. The Green-Ampt parameters XKSAT (hydraulic conductivity at natural saturation), PSIF (wetting front capillary suction), and DTHETA (volumetric soil moisture deficit at the start of rainfall) were determined for each sub-basin. The area of each soil unit within each sub-basin was computed using soil maps provided by the District and checked by maps from the Soil Conservation Service's *Soil Survey of Maricopa County, Arizona Central Part* (1977) (Plate 3, Appendix I). A log area-weighted set of Green-Ampt parameters for each sub-basin were then calculated.

Following development of the Green-Ampt parameters based upon soils information, the XKSAT and DTHETA parameters were then adjusted to account for vegetative cover and/or land use. To account for the impact of vegetative cover, the XKSAT parameters for each sub-basin were adjusted based on guidelines given in the *Hydrologic Design Manual* (1992), aerial photographs, and field observations. The DTHETA parameter was influenced by land use. DTHETA (normal) was used for the residential, industrial, commercial, and park areas, since there is intermittent moisture due to watering landscaping. The DTHETA (dry) was used for open space land areas. The DTHETA parameter was calculated as an area-weighted average based on the land use.

The "percent impervious" parameter (RTIMP) specifies the percentage of a sub-basin that is impervious. The "percent impervious" was computed for each sub-basin, as a function of zoning and land use. An existing condition Land Use Map was developed using aerial photographs and zoning information (See Plate 4, Appendix I).

The surface retention loss parameter (IA) is a function of land use and/or surface vegetative cover. IA values for each sub-basin were calculated using guidelines given in the District's *Hydrologic Design Manual.*

3.5.3 Time of Concentration (Tc)

Travel paths, lengths and slopes for each sub-basin were determined from review of the detailed topographic maps. The hydraulically most distant portion of each sub-basin was determined and the travel path to the median line of concentration measured. Travel paths were typically measured along the streets which act as major flow carriers. One or more streets may actually compose the path of flood flows. Times of

concentration were then determined using the MCUHP1 program from the District. Tc values for each sub-basin were computed using District guidelines.

3.6 Routing Parameters

3.6.1 Channel Routing

In this study, the Normal Depth Channel-Modified Puls method was used for all flow routings. Channel geometries, slopes, and Manning's roughness coefficients were estimated from available mapping, aerial photography, and from observations made during the field investigations. The channel geometries were determined based on the general flow path and the average number of streets the flow path traversed, see the table of channel routing data in Appendix II and on Plate 2, Appendix I.

The flat bottoms of the route cross-sections were determined by combining the street widths for one or more major flow carrying streets. By averaging the depth of the curb and the height of the crown, a flat bottom was assumed. The land outside of the street right-of-way was considered ineffective and ignored. A maximum channel depth of three feet was used to assure an effective route capacity.

3.6.2 Reservoir Storage Routing

Reservoir storage routing was modeled in several locations, mainly along the Grand Canal and on the Maryvale Municipal Golf Course. Storage volumes were calculated based on street and canal elevations and the upstream ponding which results. (See Storage Computation Tables in Appendix II.) Outflow from each affected sub-basin was computed based upon a combination of storm drain flows and weir computations for overtopping of the adjacent road and/or canal.

3.6.3 Flow Diversions

No attempt was made to model flow diversions at major street intersections except along 59th Avenue. In all other cases, it was assumed that the capacity of each individual street would be quickly overwhelmed and that flow would tend to follow the greatest natural gradient.

Flow diversions were modeled along the Grand Canal and consist of a combination of storm drain flow, road overtopping, and canal overflow. The flow diversions were based on weir flow over the street and canal. Storage volume computation tables with storage volumes, weir flow, and storm drain capacities are located in Appendix II.

Where storm drains exist, their capacities were computed based upon the average street slope and using Manning's Equation assuming full pipe flow conditions. A summary of major storm drains within the study area and their computed capacities is provided in Table 1. Where the storm drain originates within the study area, the full capacity of the storm drain was assumed as a base flow diversion out of the study area.

TABLE 1: MAJOR STORM DRAINS WITHIN STUDY AREA

Storm Drain Location	Flow Diverted	Storm Drain Diameter (in)	Capacity[1] (cfs)	Flows Diverted from Study Area (cfs)	Description
35th Ave.	South	48	105	0	48" enters and exits study area
39th Ave.	South	78	432	84	72" enters study area and 78" exits
43rd Ave.	South	63	218	27	60" enters study area and 63" exits
Crittenden Ave.	West	54	105[2] 58	105[2] 58	Flows west to 51st Ave. storm drain
51st Ave.	South	72	312[2] 244	312[2] 244	72" flows south out of study area
Clarendon Ave.	West	42	74	74	42" flows west to 59th Ave. storm drain
59th Ave.	South	72	272	220	72" flows south exiting study area
67th Ave.	South	48	105	0	48" flows south exiting study area
Clarendon Ave.	East	42	52	52	42" flows west out of study area
Indian School Road	West	42	52	52	42" flows west out of study area

[1]Storm drain capacity assumes pipe flowing full based upon Manning's Equation, the average street slope, and a friction factor of 0.012.
[2]Based upon hydraulic grade analysis for 51st Avenue.

Where the storm drain originates outside of the study area (i.e. north of Grand Avenue), the capacity of the storm drain entering the study area was also computed. Only the increase in storm drain capacity within the study area was diverted out of the study area.

3.7 Study Review

3.7.1 Results

Results for the 2-year 6-hour, 10-year 6-hour, and 100-year 6-hour storm events at critical study locations are summarized in Table 2. The results indicate a severe flooding potential along the Grand Canal particularly in the two noted problem areas. In particular, peak discharges for the 100-year 6-hour storm event exceed 700 cfs at 39th Avenue, 43rd Avenue, 47th Avenue, 49th Avenue and 63rd Avenue.

3.7.1.1 Area A - 64th Drive and Sunset Drive

The computed peak discharge at 63rd Avenue and Clarendon Avenue for the 100-year 6-hour event was computed to be 2057 cfs. This flow, as has been demonstrated by past flooding events, would likely overtop the Grand Canal near 63rd Avenue and across land currently occupied by a City of Phoenix water storage tank.

A large portion of the flow reaching this area originates from drainage sub-basins north of Indian School Road which concentrate flow within 59th Avenue and the Maryvale Municipal Golf Course. Other drainage flows which originate east of 59th Avenue influence the flooding in this area to a lesser extent.

3.7.1.2 Area B - 47th Drive and Crittenden Lane

The peak discharge at 47th Drive and Crittenden Lane for the 100-year 6-hour event was computed to be 709 cfs. This flow reaches the area from a sub-basin to the north and from flow along the Grand Canal. This flow originates within the industrial subdivisions to the east.

3.7.2 Comparison of Results

A comparison of results with past flooding events can only be conducted on a qualitative level. Results from the HEC-1 analysis (See Appendix VI) confirm that large flowrates and volumes will cause significant flooding on the north side of the Grand Canal. Flow will concentrate in the areas of 47th Avenue, 51st Avenue and 64th Avenue. Photography of the 1963 flood event specifically identifies the area of 64th Avenue where a canal breach occurred.

3.7.3 Conclusions

It is not possible to quantitatively compare the results of this study, however, the locations of major discharges do correspond with known flooding and ponding areas. Results from this stage of the study were later used for alternatives evaluation and preliminary design.

TABLE 2: EXISTING CONDITIONS
ESTIMATED PEAK FLOWS AT CRITICAL LOCATIONS

HEC-1 I.D.	2-YR, 6-HR FLOW (cfs)	10-YR, 6-HR FLOW (cfs)	100-YR, 6-HR FLOW (cfs)	DESCRIPTION
C40	183	444	822	Flow concentrating at 39th Avenue and Grand Canal.
D43	128	454	959	Flow overtopping 43rd Avenue continuing west.
D47S	23	219	545	Flow overtopping Grand Canal east of 47th Avenue.
CRIT	58	58	58	Flow within Crittenden Storm Drain.
D47C	51	301	709	Flow within Crittenden Lane west of 47th Avenue.
C49[B]	76	378	959	Flow concentrating at 49th Avenue and Crittenden Lane.
C51	144	491	1222	Flow concentrating at 51st Avenue and Crittenden Lane.
D51	4	221	896	Flow overtopping the Grand Canal near 51st Avenue.
C59	378	636	1041	Flow concentrating at 59th Avenue and Grand Canal.
D59	5	209	495	Flow overtopping 59th Avenue and continuing west.
SGC	190	922	2052	Flow leaving storage basin in golf course.
C63	187	929	2057	Flow concentrating at 63rd Avenue and Sunset Drive.
D63[A]	13	681	1966	Flow overtopping canal at 63rd Avenue minus storm drain flow.
C67	379	998	2122	Flow concentrating at 67th Avenue and flowing over at Turney Avenue.

[A] Area A (Plate 2) 64th Drive and Sunset Drive
[B] Area B (Plate 2) 47th Drive and Crittenden Lane.

4.0 ALTERNATIVES INVESTIGATION

4.1 Study Procedure

The alternatives evaluation stage began with a "brainstorming" session between District and CVL staff. Initially, numerous alternatives were conceived. As further discussions with District and City staff were held, these alternatives were revised and developed into six alternatives for Area A and ten alternatives for Area B.

The following procedure was used in the development and evaluation of each of the alternatives:

- Identify major flooding sources.
- Identify site constraints.
- Identify existing drainage features and opportunities.
- Develop preliminary alternatives and their components.
- Revise HEC-1 model to match each alternative.
- Develop preliminary conceptual costs.
- Identify pros and cons for each alternative.
- Identify preferred alternatives.

Later phases of the study included the development of the preferred alternatives in greater detail, refinement of the hydrologic/hydraulic models, and preparation of cost estimates and an economic comparison.

4.2 Cost Estimates

While it is necessary to consider and evaluate many different factors when comparing each of the alternatives, the overall cost of each is often of primary importance. The cost estimates developed at this stage were based on approximate construction and land acquisition costs with appropriate contingency factors applied. These cost estimates should only be used for comparison purposes. Land acquisition costs include relocation costs, where applicable. Utility relocation costs have not been included at this time since they cannot be readily identified at this stage of the study and are a common element of most alternatives.

- Construction Costs

  Construction cost estimates for each alternative were prepared based upon bid prices from past public works projects. In establishing these unit

prices, consideration was given to the magnitude of the project and any economies of scale that might be anticipated.

- Land Costs

  Private land acquisition costs were computed by District staff based on current County Assessor's maps and ownership sheets. Where land acquisition involves moving residents, relocation costs were also included. For those aspects of the alternatives which lie within publicly held property, no land acquisition costs were assumed.

- Demolition Costs

  Where existing homes will be razed, the cost of demolition was included in the construction costs.

- Landscape Restoration Costs

  Where public facilities, notably the golf course or public park, were considered as alternatives, the cost of landscape restoration was included. A high standard of improvement was considered for those cases. Where existing homes will need to be razed, a lesser standard of landscape replacement was assumed. Where detention basins would be in remote areas, only the cost of perimeter screening was assumed.

Cost estimates identifying individual elements of each alternative are included in Appendix III.

4.3 Design Elements

The following types of flood control facilities were given consideration in the preparation of alternatives. In order to provide a common basis for comparisons, and to provide the level of protection desired by the District, all elements were evaluated for a 100-year, 6-hour design storm. Alternatives may consist of one or more of the following features:

- Open Channels

  A majority of the watershed has been urbanized making the use of open channels rather restricted. An open channel offers the advantage of intercepting runoff directly without the need for an extensive subsurface collection system. Open channels may be lined or unlined. The choice between lined or unlined channels is dependant upon available rights-of-way widths, design capacity, erosion potential, maintenance requirements and aesthetic constraints.

- Closed Conduits

  Closed conduits may be utilized where available rights-of-way or open space are limited. Closed conduits may consist of either pipes or box culverts. For the alternatives presented, it was assumed that the conduit will lie within the right-of-way and therefore there would be no land acquisition costs. The cost of major lateral lines was also included in each alternative. The costs of connector pipes and catch basins for flow interception were assumed to be minor and a common element to most alternatives, and, therefore, are not included in the cost estimates.

- Detention Facilities

  Detention basins can be used to store stormwater with a controlled "bleed-off" over a prolonged period of time. It is assumed in all cases that any basins would be below ground. The cost of excavation was, therefore, based upon the required stormwater storage volume plus appropriate freeboard. This area has major storm drains which would facilitate the drainage of these basins. For remote, non-public access basins, it was assumed that water could be impounded to a maximum depth of eight feet with 4:1 sideslopes. For public access basins, such as those located within the golf course, park, or residential areas, a maximum basin depth of five feet was assumed. These assumptions were later revised and do not apply to the final recommended plan.

- Non-Structural

  Non-structural elements include the "do-nothing" or single event compensation approach, temporary or permanent floodproofing, regulation of conduit discharges by Salt River Project (SRP) and buy-out of frequently flooded homes.

4.4 Existing Drainage Features

The hydrologic investigation phase of this study confirmed that severe flooding could occur along the north side of the canal from 35th Avenue to 67th Avenue. The extent of the Federal Emergency Management Agency (FEMA) designated 100-year floodplain is identified on the Flood Insurance Rate Maps (FIRM) and is depicted on Plate 1 in Appendix I. Areas A and B, as defined above, are divided by a high point in 51st Avenue as it crosses the Grand Canal.

- Area A - 64th Drive & Sunset Drive

  A drainage area of approximately 3.0 square miles, extending from 51st Avenue to 65th Avenue, drains toward this flood prone area. The FIRM shows that approximately 70 acres of land lies within Zone A. Drainage reaches the 64th Drive area by following a northeast to southwest direction.

- Area B - 47th Drive & Crittenden Lane

  A drainage area of approximately 2.5 square miles, extending from 35th Avenue to 51st Avenue drains toward this flood prone area. The FIRM shows that approximately 130 acres of land lies within Zone A. Drainage tends to flow from north to south before being trapped by the canal and conveyed west toward 47th Drive.

4.5 Existing Storm Drains

In order to help alleviate the severe flooding that can occur in this area, the City of Phoenix has installed several major storm sewer trunk lines. These may be summarized as they exit the study areas as follows:

- 39th Avenue (N-S) - 78" Pipe
- 43rd Avenue (N-S) - 63" Pipe
- 51st Avenue (N-S) - 72" Pipe
- 59th Avenue (N-S) - 72" Pipe
- Indian School Road (E-W) - 42" Pipe

The Interstate 10 (I-10) interceptor channel forms an outfall for the 43rd Avenue, 51st Avenue, and 59th Avenue storm drains. These storm drains have been typically sized to handle a two-year storm event and while they do not provide the 100-year level of protection requested by this study, they do provide a good outfall for many of the alternatives considered.

4.6 Land Availability

Much of the watershed has already been urbanized, thereby limiting the size and degree of any alternatives which would not require some demolition. Open tracts of land were first identified as potential sites for detention basins. Six specific locations were identified as follows:

- Maryvale Municipal Golf Course (59th Ave. & Indian School Rd.)
- Undeveloped Industrial Park (Maryvale Parkway & 51st Ave.)
- Undeveloped Industrial Park (Camelback Rd. & 43rd Ave.)
- Marivue Park (Osborn & 55th Ave.)
- Undeveloped Land (39th Avenue south of Grand Canal).

- Desert West Park (67th Ave. and Encanto Boulevard)

4.7 Hydrology

As each alternative was developed, the existing condition HEC-1 model routing was modified in order to determine the effects of new flow routing and detention storage. All proposed condition hydrologic models were based upon current watershed runoff conditions. Each HEC-1 model yielded flow rates and volumes which were used in the sizing of closed conduits, channels, and detention basins. The HEC-1 model for the recommended plan in place is provided in Appendix VI.

4.8 Alternatives

This section describes each of the considered alternatives, compares their respective costs and benefits and provides a discussion of the comparison. Appendix III contains a general description, a schematic drawing, an order of magnitude cost estimate and a list of identified advantages and disadvantages for each. Area A has a total of six alternatives and Area B has a total of ten. In addition, the "Do Nothing" alternative was considered. Table 3 provides a comparison of all the alternatives. For this stage of the analysis, only the major drainage collection facilities were considered, for instance, local collector storm drain lines were not included.

4.8.1 Do Nothing Alternative

Leaving the problem areas as they currently exist may not be politically or socially acceptable, but should be considered. This alternative may be chosen because of the excessive costs and/or because of the inadequate benefits of the other alternatives. Another potential reason to default to this alternative is the reallocation of construction funds to other projects.

4.8.2 Alternatives A-1 and B-1

Buy all existing properties which are subject to flooding and have had repetitive losses. FEMA has a fund which might help finance this option.

4.8.3 Alternatives A-2 and B-2

Floodproof existing homes that are subject to flooding. Floodproofing might include some sort of permanent storm wall. Sandbags are not an option because of the need for human intervention. A cost estimate is not provided because of the difficulty of determining costs since floodproofing solutions, and the level of protection that they provide, may vary greatly.

4.8.4 Alternative A-3

Enlarge Indian School Road bridge over the Grand Canal to improve its capacity and reduce the risk of the canal overtopping its banks. No cost estimate is provided because a qualitative analysis shows that the cost of enlarging the bridge for an urban arterial is very high, this alternative does not address the local flooding problem, and it may increase the risk of flooding to the west.

4.8.5 Alternatives A-4-1 and A-4-2

Construct a detention basin within the Maryvale Municipal Golf Course to intercept the floodwaters that reach Area A. The required storage volume was estimated at 165 acre-feet for Alternative A-4-1 and 229 acre-feet for Alternative A-4-2. Alternative A-4-1 allows low flows to bypass the basin and drains the basin to the 67th Avenue storm drain. Alternative A-4-2 diverts all flows into the basin and drains the basin to the 59th Avenue storm drain. Storm drain collection systems along Camelback Road, Indian School Road, and 59th Avenue are included in both alternatives.

4.8.6 Alternative A-5

Construct a 274 acre-foot detention basin southwest of Indian School and 63rd Avenue. Construct a storm drain collection system along Indian School Road to intercept runoff from the north and divert it to the basin. Outlet the basin either to the 67th Avenue or 59th Avenue storm drains.

4.8.7 Alternative B-3

Construct a detention basin adjacent to the Grand Canal near the 39th Avenue alignment. A side weir would divert flood flows into the basin from the Grand Canal, thus leaving the excess capacity in the canal to convey flood flows contributed by downstream neighborhoods.

4.8.8 Alternative B-4

Construct a channel along the north side of the Grand Canal to intercept runoff. Construct a downstream channel or storm drain south to the I-10 interceptor channel.

4.8.9 Alternative B-5

Construct a drainage channel along the north side of the Grand Canal which would outlet into a detention basin located on the north side of the canal between 51st and 55th Avenues. This property is currently an undeveloped industrial park. Alternative B-5 includes a 192 acre-foot detention basin with a 24-inch bleed-off pipe into the 51st Avenue storm drain.

4.8.10 Alternative B-6

Similar to Alternative B-5 except bypass flows would continue along 51st Avenue within a new 72-inch storm drain along 51st Avenue storm drain. A 119 acre-foot detention basin would be required.

4.8.11 Alternative B-7

Construct a storm drain collection system westerly along Indian School Road and southerly along 51st Avenue. Low flows would remain in the 51st Avenue storm drain while larger flows would be diverted into a 157 acre-foot detention basin in the undeveloped industrial park mentioned in Alternatives B-5 and B-6. The basin would drain south to the existing I-10 interceptor channel.

4.8.12 Alternative B-8

Construct a linear detention basin on the north side of the Grand Canal. This basin would: (1) Remove the first row of houses adjacent to the canal, (2) Remove the first row of houses, Crittenden Lane, and the second row of houses, (3) Lie on the north side of a relocated section of the Grand Canal, or (4) A combination of two of these options. The detention basin would outlet to the existing 43rd Avenue or 51st Avenue storm drain.

4.8.13 Alternative B-9

Construct a detention basin on vacant land located at the southwest corner of Camelback Avenue and 43rd Avenue to intercept flows that cross Grand Avenue in an existing 60-inch storm drain. The basin would outlet back to the 43rd Avenue storm drain.

4.8.14 Alternative B-10

Construct a detention basin in the Marivue Park, south of the canal near 55th Avenue. Construct an interceptor channel or storm drain along the north side of the Grand Canal and along Osborn Road. The basin would bleed off into the 59th Avenue storm drain.

4.9 Comparison of Alternatives

A comparison of the mitigation solutions for Area A and Area B involves looking at the relative costs, the level of flood protection provided, the neighborhood impacts, the number of households to be moved, whether existing storm drain facilities are used, and the future maintenance requirements for each of the preliminary alternatives (See Table 3). The outcome of this analysis should be an intermediate group of alternatives that are equitable when the above factors are considered.

TABLE 3: ALTERNATIVE COMPARISON
(PREFERRED ALTERNATIVES ARE SHOWN SHADED)

Alternative	Total Cost	Land Acquisition and Related Costs[1,2]	Construction Costs[1,3]	Number of Relocations[1]	11 Maintenance[1]	Utilizes Exist. Facilities[1]	Public Impact[1]	Level of Protection
Do Nothing	0	0	0	0	Recurring	N/A	-	0
A-1	$ 8,207,000	$ 6,912,000	$ 1,295,000	65	Recurring	N/A	-	100-yr
A-2	Unknown	0	Unknown	0	Recurring	N/A	-	Unknown
A-3	Unknown	Unknown	Unknown	0	Recurring	Possibly	0	less than 100-yr
A-4-1	$13,549,620	0	$13,549,620	0	Occasional	Yes	-	100-yr
A-4-2	$15,264,900	0	$15,264,900	0	Occasional	Yes	-	100-yr
A-5	$19,664,700	$ 9,536,400	$10,128,300	37	Yes	Yes	+	100-yr
B-1	$ 6,236,600	$ 5,025,600	$ 1,211,000	77	Recurring	N/A	-	100-yr
B-2	Unknown	0	Unknown	0	Recurring	N/A	-	Unknown
B-3	$ 8,947,700	$ 7,680,000	$ 1,267,700	0	Occasional	Yes	0	less than 100-yr
B-4	$22,540,300	$ 5,025,600	$17,514,700	77	Yes	Yes	+	100-yr
B-5	$13,360,000	$ 8,905,200	$ 4,454,800	77	Occasional	Yes	0	100-yr
B-6	$13,047,520	$ 8,905,200	$ 4,142,320	77	Occasional	Yes	0	100-yr
B-7	$19,768,300	$ 3,879,000	$15,889,300	0	Occasional	Yes	0	100-yr
B-8	$15,276,100	$12,306,000	$ 2,970,100	170	Yes	Yes	+	100-yr
B-9	$ 7,488,820	$ 4,764,000	$ 2,724,820	0	Occasional	Yes	0	less than 100-yr
B-10	$13,084,340	$ 2,512,800	$10,571,540	39	Yes	Yes	0	100-yr

1 Land Acquisition & Related Costs - Includes the cost of purchasing property and relocating residents, where applicable.
Construction Costs - Includes construction and related engineering costs
Number of Relocations - The number of residences whose occupants have to be relocated.
Maintenance - "Recurring" refers to the required maintenance, and the associated costs, after major storm events.
"Occasional" refers to the maintenance, and the associated costs, for upkeep of unimproved channels and/or detention basins.
"Yes" refers to the maintenance, and the associated costs, required for a park.
Utilizes Existing Facilities - Signifies whether the alternative utilizes any existing drainage facilities.
Public Impact - Reflects whether there are any long term public impacts caused by the alternative, and whether the impact is positive (+) or negative (-). A positive, long term impact may be the creation of a new area park and a negative long term impact may be that a vacant parcel is left. A 0 indicates negligible public impact.

2 Costs include 20% surveying and other acquisition costs.

3 Costs include 40% engineering and contingencies costs.

4.9.1 Common Alternatives

Alternatives A-1 and B-1, buying out affected residents, appears to be relatively inexpensive. However, because of the difficulty in identifying which residences get flooded, a specific cost is difficult to identify. Additionally, the idea of relocating 65 families from Area A and 77 families from Area B does not make this alternative very attractive.

Alternatives A-2 and B-2, the floodproofing alternatives, are difficult to compare with the other structural flood control alternatives because of the lack of cost-effective, passive floodproofing methods. Floodproofing methods that are suggested by FEMA, such as raising the finished floors of buildings, or moving the buildings to other locations, are not realistic or cost-effective options for this area. Constructing floodwalls may protect finished floors, but increase adjacent street flooding which does not allow residents free access to, or from, their homes.

Alternatives A-3 and B-3 should be eliminated from further consideration because of their high costs and inadequate level of protection.

4.9.2 Area A Alternatives

Three alternatives remain for Area A: Alternatives A-4-1, A-4-2, and A-5. Alternatives A-4-1 and A-4-2 cost the least because the proposed detention basin for each case is located in the Maryvale Municipal Golf Course. This alternative does not require residents to relocate. The other remaining alternative, A-5, would provide a 100-year level of protection at a slightly greater cost than A-4-1 and A-4-2; however, it would have a much larger impact on residents. A total of 36 residents, one church, and the recently constructed City of Phoenix fire station would be required to relocate. A determining factor in recommending a 100-year protection solution for Area A would therefore be whether the City of Phoenix Parks and Recreation Department would allow a detention basin in the existing golf course.

4.9.3 Area B Alternatives

Seven alternatives remain for Area B: Alternatives B-4, B-5, B-6, B-7, B-8, B-9, and B-10. Alternative B-9 should be eliminated because, although it does provide relief to the existing 43rd Avenue storm drain, it does not provide significant flooding relief to Area B. Alternatives B-4 and B-7 should be eliminated due to their high costs. Alternative 10 should be removed from consideration because of the necessity of crossing the Grand Canal, which in turn elevates costs. The three remaining alternatives, B-5, B-6, and B-8, all have relatively close costs.

All three of the remaining alternatives provide a 100-year level of protection. They also impact the public because they require residents to relocate in order for drainage facilities to be built. Alternative B-8 has the greatest public impact, however, because it requires the most residents to relocate. All three alternatives require the construction of a detention basin. While Alternatives B-5 and B-6 propose eight feet

deep unimproved basins which will be fenced, Alternative B-8's linear detention basin along the Grand Canal may be an ideal location for a city park. A determining factor for making a recommendation for a 100-year flooding mitigation solution for Area B might be whether the City would want to maintain another park.

4.10 Recommendations

Thus far the analysis has resulted in three 100-year flooding mitigation solutions for both Area A and Area B. Prior to proceeding with selection of a final alternative the following steps were recommended:

1. The results of the analysis should be discussed with District and City staff.

2. A public meeting should be held.

3. Responses to a public survey, distributed by the District should be received and reviewed.

4. Interim solutions which provide something less than a 100-year level of protection, should be investigated.

5.0 DEVELOPMENT OF DESIGN OPTIONS

5.1 Identification of Floodprone Areas

Upon completion of the alternatives investigation phase, a meeting was held with District and City staff to discuss the study's results and recommendations, and to determine how to proceed. Because of the high costs associated with providing 100-year protection, a decision was made to identify options that offer a lower level of protection. To assist in evaluation of lower levels of protection more specific identification of the flooding problem was required.

A Floodprone Area Map (Appendix IV) was prepared to help identify the most floodprone areas. The map shows the FEMA floodplain limits and also areas that are most likely to flood during higher frequency events. The limits of more frequent flooding were identified by assuming that ponding would occur to an elevation no higher than the adjacent top of bank elevation of the Grand Canal or the adjacent street.

This exercise reinforced the identification of Areas A and B as areas of frequent flooding and also identified another flooding area on the north side of the Grand Canal at Whitton Avenue between 55th and 57th Avenues. This area contains two houses that experience recurrent flooding as reported by City of Phoenix (COP) flooding reports. (Appendix IV).

In order to gather specific information regarding flooding in the study area, the District distributed questionnaires to all residents within the FEMA designated floodplain.

A copy of this questionnaire is included in Appendix IV. After receiving the responses to the questionnaire, the District prepared an exhibit illustrating reported flooding locations. A table summarizing the results of the survey information is included in Appendix IV. The information is also displayed on the Floodprone Area Map (Appendix IV). This survey information once again reinforced the validity of the study locations, including Area C.

5.2 Lower Level of Protection Options

5.2.1 Area A

Option 1: A revision to Alternative A-5 which would include a downsized detention basin, a new storm drain in Clarendon Avenue, and an outfall to the 59th Avenue storm drain.

Option 2: A revision to Alternatives A-4-1 and A-4-2 which would include the use of the existing lakes in the Maryvale Municipal Golf Course for detention storage. The lakes would be regraded to provide additional storage through excavation and berming. This option would divert the flow in the 59th Avenue storm drain through the proposed detention basins and drain them to the Indian School Road storm drain.

Option 3: Construction of new storm drains in Sunset Drive and Clarendon Avenue which would both drain to a new storm drain in 63rd Avenue. The new 63rd Avenue storm drain would outlet to a new detention basin in either Desert West Park (A-6-R1) or vacant property on the south of the Grand Canal (A-6-R2).

All three options are illustrated on Plate A - Lower Level, in Appendix IV.

5.2.2 Area B

Option 1: A revision to Alternative B-6 which would include a detention basin in an undeveloped industrial park north of the Grand Canal and west of 51st Avenue. The 51st Avenue storm drain would be diverted into the basin and drainage would be metered back into the existing 51st Avenue storm drain. The Crittenden Lane storm drain would be improved by replacing existing catch basins with larger ones and adding catch basins where needed. The Crittenden storm drain would outlet directly to the 51st Avenue storm drain.

Option 2: A revision to Alternative B-4 which would include an improved storm drain in Crittenden Lane and which would outlet to a new storm drain in either 51st Avenue or 47th Avenue. The two options for Area B are illustrated on Plate B - Lower Level, in Appendix IV.

5.2.3 Area C

Option 1: A new option developed to solve the neighborhood flooding problem at Whitton Avenue near 57th Avenue. An existing residence would be removed and an

existing earthern channel, adjacent to the Grand Canal, regraded to drain to the east. The channel would cross 55th Avenue and discharge to the detention basin identified for Area B, Option 1.

5.3 Public Meeting

A public meeting was held on October 26, 1995. At this meeting, residents were presented with the 100-year protection and the lower level protection options for Areas A, B, and C, as well as their corresponding costs. To provide consistency and simplify the presentation, the 100-year alternatives were renamed as follows: Alternative A-5 became Option 1 and Alternative A-4-2 became Option 2 for Area A, and Alternative B-6 became Option 1, Alternative B-10 became Option 2, and B-8 became Option 3 for Area B. The plates and cost estimates for each option are located in Appendix IV.

5.4 Analysis of Options

The decision regarding which option to recommend as a final solution was reached by considering the costs as well as the practical and political ramifications of each option. Table 4 summarizes the costs.

5.4.1 Area A

The 100-year protection options for Area A were rejected because of their extremely high costs. Of the Lower Level Protection options, Option 2, using the Maryvale Municipal Golf Course, was rejected because it would not adequately relieve flooding in Area A. Option 3 was rejected because while it would provide some relief, the basic flooding problem would remain and the system would provide little utility following implementation of 100-year regional drainage solutions. In addition, using Desert West Park for detention storage was not considered acceptable to the City of Phoenix Parks and Recreation Department and the vacant lot south of the Canal did not provide an appreciable amount of storage.

Option 1 was recommended as a final solution with some minor changes. The public meeting demonstrated support from area residents that would be relocated and who are frustrated by the continual flooding they experience. Rather than construct a new Clarendon Avenue storm drain and a new 63rd Avenue outfall, as originally outlined by this option, the construction of new storm drain would be minimized by utilizing the existing Clarendon storm drain as an outfall for the proposed detention basin.

5.4.2 Area B

The 100-year design options for Area B were rejected because of their high costs and the need for considerable resident relocations. Option 2, Lower Level Protection, was eliminated because it probably would not significantly improve the flooding situation and could not be later adapted into an 100-year regional solution. Option 1 was selected because of the ideal location of available, vacant property for use as a detention basin. It was decided to deepen the basin and thus limit the amount of property acquisition. the basin would be sized for the 100-year flood event.

TABLE 4: COMPARISON OF COSTS

OPTION	LAND ACQUISITION COSTS*	CONSTRUCTION COSTS*	TOTAL COSTS
Area A, 100-Yr Protection			
Option 1	$8,336,400	$10,128,300	$18,464,700
Option 2	0	$15,264,900	$15,264,900
Area A, Lower Level Protection			
Option 1	$2,130,120	$1,644,720	$3,744,840
Option 2	0	$3,375,400	$3,375,400
Option 3 (A-6R-1)	0	$2,635,416	$2,635,416
(A-6R-2)	$286,344	$2,284,450	$2,570,794
Area B, 100-Yr Protection			
Option 1	$8,905,200	$4,142,320	$13,047,520
Option 2	$2,512,800	$10,571,540	$13,084,340
Option 3	$12,306,000	$2,970,100	$15,276,100
Area B, Lower Level Protection			
Option 1	$3,878,938	$1,649,620	$5,528,558
Option 2	0	$2,544,500	$2,544,500
Area C, Lower Level Protection			
Option 1	0	$282,450	$282,450

* Land Acquisition Costs include a 20% contingency factor. Construction Costs include a 40% contingency factor.

6.0 PRELIMINARY DESIGN PLANS

6.1 Design Elements

6.1.1 Area A

The major drainage feature for Area A is the proposed Sunset Drive detention basin (Sheet A-1, Appendix V). Thirty-six residences and Sunset Drive will be demolished to allow for excavation of the proposed 10 feet deep basin. The existing sewer line in Sunset drive will be removed to the southern right-of-way of Indian School and then plugged. The existing water line will be removed and capped at Indian School Road and at 63rd Avenue.

Two spillways are to be constructed to carry street drainage into the basin. One is located at the existing Indian School Road and Sunset Drive intersection. The other is located at the existing Sunset Road and 63rd Avenue intersection.

A section of new 36-inch diameter storm drain will connect to the existing Clarendon Avenue storm drain at the manhole at 62nd Avenue and Clarendon. (See Sheet A-2, Appendix V.) This new storm drain will convey runoff from the 62nd Avenue/Clarendon Avenue and the 63rd Avenue/Clarendon Avenue intersections into the basin. This new length of storm drain will also serve as a secondary outlet from the basin when the depth of water in the basin provides sufficient head to reverse the flow in the pipe. The existing Clarendon Avenue storm drain will, therefore, act also as an outfall for the basin. The primary outlet from the basin will be through a proposed 30-inch pipe connected to an existing stub from the Indian School Road storm drain (Sheet A-1, Appendix V).

In addition to removing affected residents from this area, the construction of this basin should provide downstream relief to the existing 59th Avenue storm drain by decreasing the peak inflow from the Clarendon Avenue storm drain. The preliminary design plans and cost estimate for Area A are located in Appendix V.

6.1.2 Area B

The main drainage feature of Area B is a detention basin (see Sheets B-1 through B-4, Appendix V) located on undeveloped property along the north side of the Grand Canal and west of 51st Avenue. The proposed 17 feet deep basin is designed to store the 100-year event. Runoff in 51st Avenue will be diverted westerly to the basin by reconstructing the existing pavement to a one-way crown. Approximately 120 linear feet of curb along the western edge of pavement will be depressed to intercept the flows and direct them to the proposed spillway. The existing 72-inch storm drain within 51st Avenue will be diverted to the basin just south of Whitton Avenue. The diversion structure will be designed to allow low flows up to one foot deep to continue south in the existing storm drain. The proposed basin will outlet to the 51st Avenue storm drain just north of the Grand Canal through a 54-inch pipe. (See Sheet B2 in Appendix V.)

Diverting flow from 51st Avenue and from the 51st Avenue storm drain will provide relief to the downstream storm drain in 51st Avenue. As a result, the Crittenden Avenue storm drain should perform more efficiently, thus providing relief from flooding along Crittenden Lane. The preliminary plans, including the hydraulic grade line and the cost estimate, are included in Appendix V.

6.1.3 Area C

Flooding relief to Area C involves the demolition of one residence on Whitton Avenue, the construction of a spillway to carry runoff from Whitton Avenue, and a new drainage channel adjacent to the Grand Canal. (See Preliminary Plan Sheet C-1 in Appendix V.) The proposed channel will replace an existing earthen channel which outfalls to the west. The proposed concrete channel will be constructed to intercept flows from 57th Avenue and from the proposed Whitton spillway and carry the runoff easterly to the proposed 51st Avenue detention basin described for Area B. At 55th Avenue, a piped crossing is proposed which will accept flows from a short section of proposed storm drain in 55th Avenue. Easterly of 55th Avenue the flows will be contained in a concrete channel located at the southern boundary of the Borman Junior High School property. An earthen channel was considered during the initial stages, but a concrete channel section was necessary due to the limited available area upstream of 55th Avenue and the need to minimize land acquisition within the school property. The preliminary plan and the cost estimate for Area C are located in Appendix V.

6.2 Storm Drain Analysis

6.2.1 Area A

A hydraulic grade line analysis was not completed for Area A since the predicted flow within the system will not change significantly following plan implementation. However, some reduction in the flow reaching the storm drain can be anticipated as a result of the Area C flow diversion and conveyance of Clarendon Avenue flows into the Area A detention basin.

6.2.2 Area B

As a means to evaluate the capacity of the existing storm drainage system and the impact of the proposed flood control improvements in Area B, a hydraulic grade line analysis was conducted for both existing and proposed conditions. "As-built" construction documents were obtained for the 51st Avenue storm drain trunk line and its storm drain laterals. The 51st Avenue storm drain outlets to the I-10 interceptor channel through an 84-inch diameter pipe. The storm drain size diminishes as it extends north to a point approximately 2500 feet north of Indian School Road. Storm drain laterals include McDowell Road, Thomas Road, Crittenden Lane, Indian School Road and Campbell Avenue.

Information from the "as-built" drawings (See Plan Bibliography) was developed into a spreadsheet program which was used to analyze the storm drain capacity using the Manning's formula and estimated junction losses. The spreadsheet allowed the

comparison of the computed hydraulic grade line with the existing road grades. Flow surcharge locations could thus be easily identified.

The sizes and locations of existing catch basins which contribute to the storm drain trunk line and lateral lines were provided as an input variable. It was estimated that the maximum catch basin inflow would be 1.08 cfs/ft after accounting for clogging factors. By assuming that the catch basins will attain their maximum inflow capacity, where the hydraulic gradient in the storm drain line permits, a trial and error procedure was adopted to determine the maximum capacity of the existing system. The maximum hydraulic gradient was assumed to be within plus or minus 0.5 feet of the existing road grade. Results from the storm drain analysis are documented in Table 5.

TABLE 5: 51ST AVENUE STORM DRAIN SYSTEM FLOWS

	FLOWRATE (cfs)	
Location	**Existing**	**Proposed**
51st Avenue at I-10	508	485
51st Avenue at McDowell	508	485
51st Avenue at Thomas	354	332
51st Avenue at Crittenden	257	189
51st Avenue at Indian School	186	N/A
McDowell Road	62	61
Thomas Road	45	92
Crittenden Lane	58	155
Indian School Road	75	N/A

N/A Not analyzed.

The 51st Avenue storm drain system south of the Grand Canal will remain unchanged. Just north of the Crittenden storm drain junction, all flow from the 51st Avenue storm drain will be diverted into the 51st Avenue detention basin. This will have the effect of improving the system's capacity both north and south of Crittenden Lane.

The results indicate that the Crittenden Lane storm drain's capacity will increase from 58 cfs to 155 cfs. Additional capacity will also be available in the 51st Avenue storm drain system to the north and the Thomas Road storm drain to the south. The increased capacity in the system could allow future improvements in the existing storm drainage systems through the addition of larger and more frequent catch basins. However, care must be taken to ensure that the trunk line's capacity is not overtaxed as it is under the current conditions.

6.3 Proposed Condition Hydrologic Analysis

The existing condition hydrologic analysis was revised to reflect the proposed conditions with the storm drain and detention basin improvements in place. Peak discharges for the 2, 10 and 100-year, 6-hour storm events under existing and proposed conditions are summarized in Table 6. The results from the 51st Avenue storm drain analysis were included in the revised hydrologic analysis.

6.3.1 Area A

The results indicate that the Area A detention basin will approximately contain the runoff from a 10-year 6-hour storm event. This is in contrast to the almost 700 cfs that is predicted to result from the same storm under existing conditions. A less significant improvement can be anticipated for the 100-year 6-hour storm event when the existing discharge of approximately 2,000 cfs would be reduced to 1,600 cfs. Basin characteristics are summarized in Table 7.

6.3.2 Area B

The capacity of the Crittenden storm drain will be improved from approximately 60 cfs to 160 cfs. This will allow full conveyance of the 2-year 6-hour storm event along Crittenden lane. The reduction in street flow above the 2-year 6-hour event is not significant, however, proposed regrading of 51st Avenue would provide relief from ponding and would improve the street system's conveyance capacity. The full 100-year 6-hour storm event would be contained within the basin. Basin characteristics are summarized in Table 8.

7.0 CONCLUSIONS

7.1 Introduction

A step-by-step procedure has been adopted in the formulation of the alternatives and recommended plan presented in this report. Continual communications have been kept with District staff and the City of Phoenix to ensure agreement at critical stages of the project.

Three flooding problem areas have been identified in this study and structural improvements recommended for each area. The flooding problem areas were identified first through flooding reports provided by the City of Phoenix. Severe flooding on the north side of the Grand Canal has been documented since 1963. A recent survey conducted by the District has further identified specific residents that have experienced flooding within the FEMA designated 100-year floodplain. In addition, residents present at the public meeting held in October 1995 explained the nature of their personal experiences.

TABLE 6: EXISTING AND PROPOSED CONDITIONS ESTIMATED PEAK FLOWS AT CRITICAL LOCATIONS

HEC-1 I.D.	2-YR, 6-HR FLOW (cfs)	10-YR, 6-HR FLOW (cfs)	100-YR, 6-HR FLOW (cfs)	DESCRIPTION
C40	183 (N/C)	444 (N/C)	822 (N/C)	Flow concentrating at 39th Avenue and Grand Canal.
D43	128 (N/C)	454 (N/C)	959 (N/C)	Flow overtopping 43rd Avenue continuing west.
D47S	23 (4)	219 (183)	545 (506)	Flow overtopping Grand Canal east of 47th Avenue.
CRIT	58 (121)	58 (155)	58 (155)	Flow within Crittenden Storm Drain.
D47C	51 (7)	301 (239)	709 (651)	Flow within Crittenden Lane west of 47th Avenue.
C49[B]	76 (N/C)	378 (305)	959 (899)	Flow concentrating at 49th Avenue and Crittenden Lane.
C51	144 (N/C)	491 (409)	1222 (1162)	Flow concentrating at 51st Avenue and Crittenden Lane.
D51 (Flow Contained)	4 (0)	222 (0)	896 (0)	Flow overtopping the Grand Canal near 51st Avenue.
C59	378 (277)	636 (372)	1041 (532)	Flow concentrating at 59th Avenue and Grand Canal.
D59 (D59W)	5 (0)	209 (6)	495 (134)	Flow overtopping 59th Avenue and continuing west.
SGC	190 (N/C)	922 (N/C)	2052 (N/C)	Flow leaving storage basin in golf course.
C63	187 (182)	929 (879)	2057 (2046)	Flow concentrating at 63rd Avenue and Sunset Drive.
D63[A] (DWRA)	13 (0)	681 (32)	1966 (1591)	Flow overtopping canal at 63rd Avenue minus storm drain flow.
C67	379 (N/C)	998 (N/C)	2122 (N/C)	Flow concentrating at 67th Avenue and flowing over at Turney Avenue.

[A] Area A (Plate 2) 64th Drive and Sunset Drive
[B] Area B (Plate 2) 47th Drive and Crittenden Lane.

Proposed conditions noted in Parentheses.
N/C = No change

Development of the hydrologic model by CVL, using detailed topographic mapping at a scale of 1" = 200' and 1' contour interval, helped to confirm the location and provide the order of magnitude of the flooding problem. A review of the detailed topography helped to identify specific recurrent flooding areas. This information was then further verified through tabulation and mapping of residents' responses to the questionnaire prepared by the District.

Early stages of the alternatives formulation entailed the review of existing physical constraints and opportunities. While a majority of the watershed is urbanized, several vacant or undeveloped parcels remain. These each presented opportunities for future drainage facility sites. Additional alternatives considered included the relocation of many of the worst affected residences.

In any of the proposed 100-year level of protection alternatives, the sizing of adequate stormwater collection facilities posed extreme challenges which required either extensive property acquisition and residents' relocation or expensive construction of subsurface drainage facilities within existing rights-of-way. As a result, the order of magnitude of costs for Areas A and B appeared to exceed initial District expectations. The cost of improvements also appeared to exceed the cost of acquiring individual properties which have experienced recurrent flooding problems.

In order to bring costs in line with the anticipated flood relief benefits, it was decided to explore options which provide less than a 100-year level of protection (the standard benchmark for District projects). The approach taken was to eliminate some of the more costly elements presented in the 100-year level of protection alternatives, develop a mitigation program which best utilizes the existing drainage facilities, and to work within existing land parcel and right-of-way constraints. The extensive storm drainage collection facilities proposed for Areas A and B were thus eliminated and replaced with adaptations of the existing storm drainage systems.

7.2 Area A

For Area A, the proposed flood control facilities consist of a 51 acre-foot detention basin constructed on the site of 36 existing single family residential homes and the right-of-way for Sunset Drive. The basin will be drained via existing storm drainage systems within both Indian School Road and Clarendon Avenue. This basin lies at a natural low area behind the Grand Canal and one that has flooded on many past occasions thus reducing the need for extensive stormwater collection facilities. A majority of the drainage will reach this site via the remaining street network, namely along Indian School Road, 63rd Avenue, or Clarendon Avenue.

TABLE 7: AREA A - SUMMARY OF SUNSET DRIVE DETENTION BASIN FLOW CHARACTERISTICS

LOCATION (HEC-1 ID)	STORM EVENT			
	Baseline Condition	2-Year	10-Year	100-Year
51st Ave. Inflow (cfs) (D59W)	0	0	6	134
Total Inflow (cfs) (C63)	0	182	879	2046
Total Outflow (cfs) (SA)	0	21	87	1646
Indian School S.D. Outflow (cfs) (DSAW)	0	20	20	20
Clarendon S.D. Outflow (cfs) (DSAE)	0	0	35	35
Highwater Elevation (ft)	1087	1089	Above 1097	Above 1097
Volume (acre-ft)	0	9	51	51

TABLE 8: AREA B - SUMMARY OF 51ST AVENUE DETENTION BASIN FLOW CHARACTERISTICS

LOCATION	STORM EVENT			
	Baseline Condition	2-Year	10-Year	100-Year
51st Ave. Inflow (cfs) (D51)	0	124	389	1142
55th Ave. Inflow (cfs) (CCHAN)	0	96	205	367
Total Inflow (cfs) (CB)	0	225	598	1517
Total Outflow (cfs) (SB)	0	18	87	100
Highwater Elevation (ft)	1086	1088	1092	1100
Volume (acre-ft)	0	22	67	156

7.3 Area B

For Area B, the proposed flood control facilities include a 156 acre-foot detention basin constructed on vacant property located north of the Grand Canal and west of 51st Avenue. This basin will flood to a depth of approximately 14 feet during a 100-year storm event. The existing 72-inch 51st Avenue storm drain system, which currently drains to the I-10 interceptor channel, will be modified to outlet to this new detention basin. The existing 54-inch Crittenden Lane storm drain will continue to outlet to the 51st Avenue storm drain and drain south to the I-10 channel. A secondary relief will be provided via a new 54-inch storm drain which will drain the detention basin but which will also allow for backflow should the 51st Avenue storm drain capacity be exceeded. New catch basins will be installed along Crittenden Lane and 51st Avenue in order to intercept increased flow. In addition, 51st Avenue will be regraded so as to direct surface runoff into the detention basin and to help relieve the ponding that occurs on Crittenden Lane east of 51st Avenue.

7.4 Area C

A third flooding problem area, Area C, was identified during the course of the study and solutions to the flooding proposed. Area C is located near 57th Drive and Whitton Avenue. The proposed flood control facilities include removal of one residence, construction of concrete spillways and a concrete lined channel adjacent to the Grand Canal from 57th Avenue east to the detention basin identified in Area B. The solution includes a concrete box culvert underneath 55th Avenue and acquisition of new right-of-way from the Borman Junior High School.

7.5 Summary of Costs

Preliminary cost estimates have been prepared for the three flood mitigation areas identified in this study. These cost estimates are summarized below and detailed in Appendix V:

Summary of Preliminary Construction Costs

Area A		
Construction	$1,799,460	
Land Acquisition	2,130,000	
Subtotal		**$3,929,460**
Area B		
Construction	$2,485,464	
Land Acquisition	2,640,000	
Subtotal		**$5,125,464**

Area C		
Construction	$631,500	
Land Acquisition	120,000	
Subtotal		**$751,500**
Grand Total A, B & C		**$9,806,424**

These cost estimates are based upon the preliminary design plans presented in Appendix V and unit costs developed for this project. A 20 percent contingency factor has been applied to both the estimated land acquisition and construction costs.

7.6 Project Phasing

Areas A and B are hydrologically separate from each other. As a result, it should be possible to construct facilities for either project independently. Area C facilities will have some effect in reducing flood flows which reach 59th Avenue and, therefore, Area A. Implementation of Area C depends upon the construction of the 51st Avenue detention basin (Area B). Area C improvements, therefore, cannot be implemented without prior construction of Area B facilities.

8.0 RECOMMENDATIONS

8.1 Plan Implementation

A flood mitigation project has been developed which addresses the flooding situation in three neighborhoods that border the Grand Canal. These projects have been developed to solve a local flooding problem but may, at a later date, be incorporated into an Areawide Drainage Master Plan (ADMP). The District already has a contract underway with another consultant for the Maryvale Area Drainage Master Study (ADMS) which will study regional drainage issues.

The flooding situation identified and explained in this study has existed since the area was first developed and has continually been an issue of concern for area residents and the City of Phoenix. It is, therefore, recommended that the project move forward expeditiously with the preparation of final design plans, parcel acquisition, and construction. Vacant property which forms the basins for the Area B flood control project is under development pressures and has recently been discussed as the location for a major league, spring training, baseball stadium. Early adoption of this report may allow for the consideration of a joint use flood control and recreational facility with possible cost benefits to the District and the Maricopa County Stadium District.

A second public meeting should be held to present the proposed flood control solution to area residents, followed by meetings with the City of Phoenix Council and the Maricopa County Board of Supervisors.

8.2 Future Studies

Alternatives developed as part of this study should be reviewed and given consideration as part of the ADMP. Other concepts that should be given consideration include the use of the Grand Canal as a floodwater conveyance system and the use of several undeveloped parcels adjacent to the canal for offline detention storage and canal peak flow control.

Ultimately, structural flood control improvements may help to reduce or eliminate the currently designated FEMA 100-year floodplain. Review of the detailed topographic maps used in this study illustrates that the risk of flooding within the designated 100-year floodplain varies from street to street and even house to house. If field surveys are conducted for the finished floors of houses currently designated within the 100-year floodplain, it may be possible to demonstrate that the flood insurance requirement is not necessary in all cases. It may also be possible to demonstrate a reduction in the current floodplain limits.

The storm drainage systems within this area are inadequate for storms greater than a 2-year event and, in some cases, may not meet that minimum requirement. The hydraulic grade line analysis conducted as part of this study could be expanded upon to help further illustrate the functionality of the existing system and to help in identifying other areas of potential improvement.

9.0 BIBLIOGRAPHY

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10.0 PLAN BIBLIOGRAPHY

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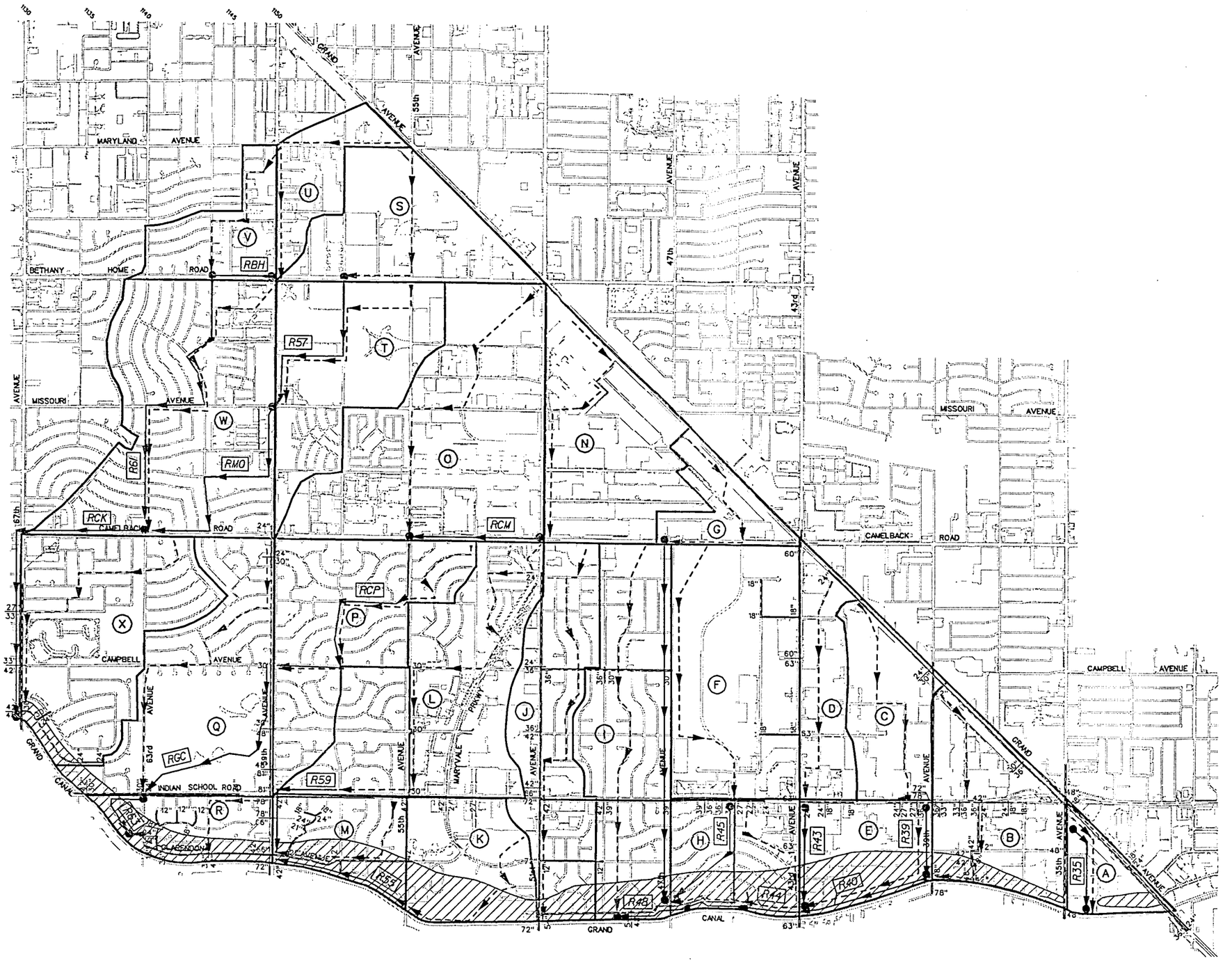
APPENDIX I
HYDROLOGIC APPENDIX

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF
MARYVALE
FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

DRAINAGE AREA & FLOW ROUTING MAP

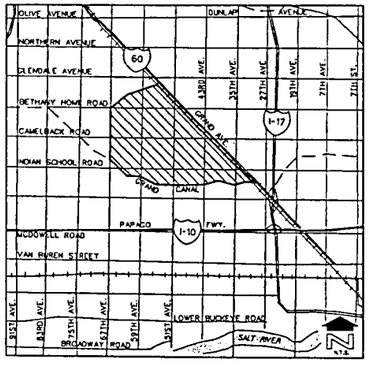
PLATE 1



LEGEND

- Drainage Basin Boundary
- (A) Drainage Basin Number
- 18" Storm Drain Location & Size
- FEMA 100-Year Flood Zone
- Lag Time Flow Path
- RCM Route Number & Flow Path
- Routing Delimiter

VICINITY MAP



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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

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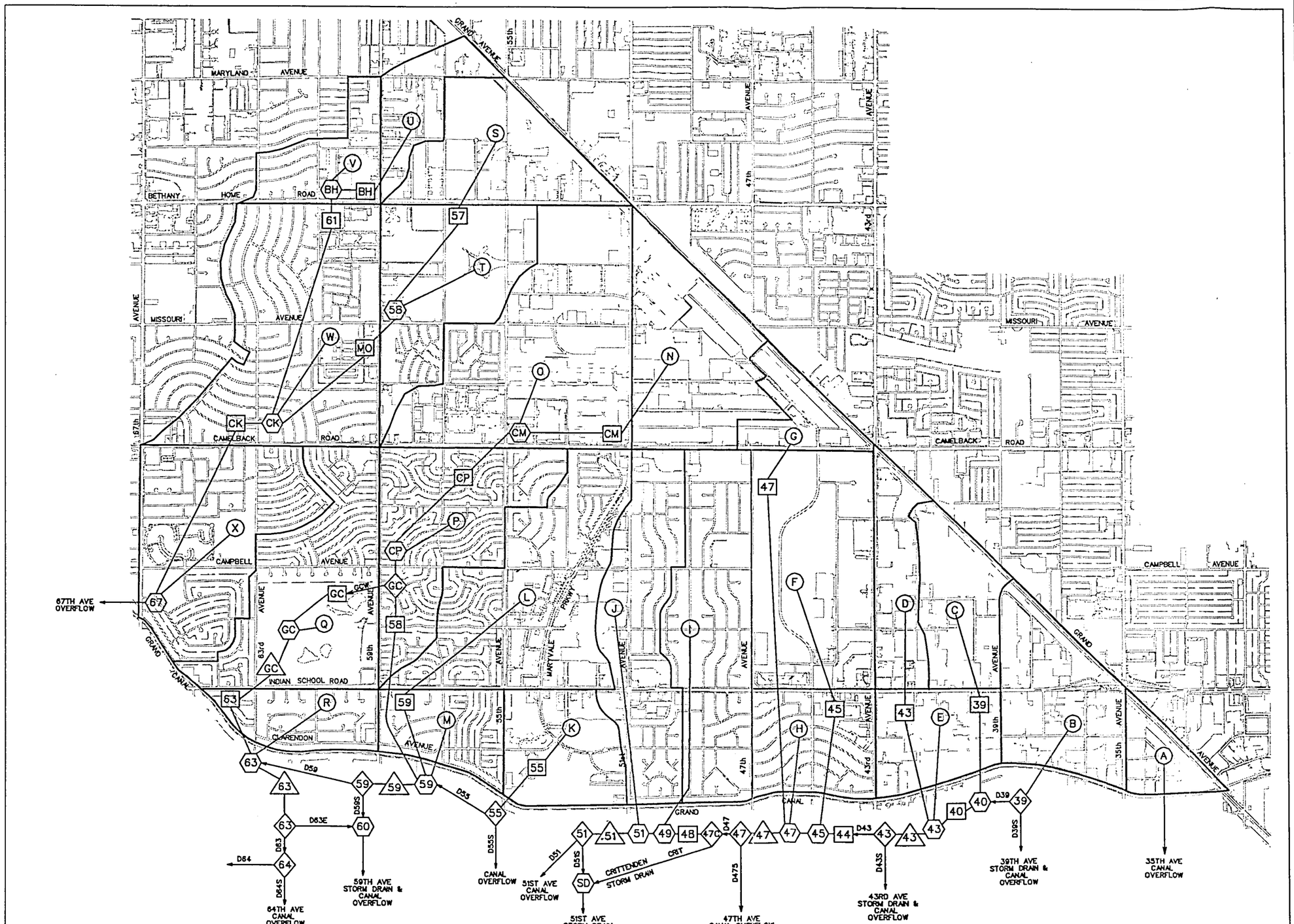
CHIEF ENGINEER AND GENERAL MANAGER

SHEET OF

JOB NO. 950024



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF
MARYVALE
FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

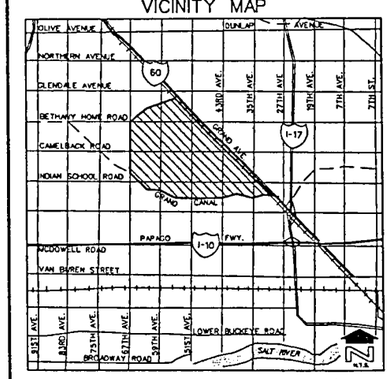
EXISTING HEC-1 SCHEMATIC

PLATE 2

LEGEND

- Drainage Basin Boundary
- T — Compute Runoff from Sub-Basin (T)
- 57 — Route Hydrograph (R57)
- S — Compute Runoff from Sub-Basin (S)
- 58 — Combine Hydrographs (C58)
- 59 — Divide Hydrograph (D59)
- D59S — D59S Divert South
- 39 — Route Hydrograph through Storage (S39)

VICINITY MAP



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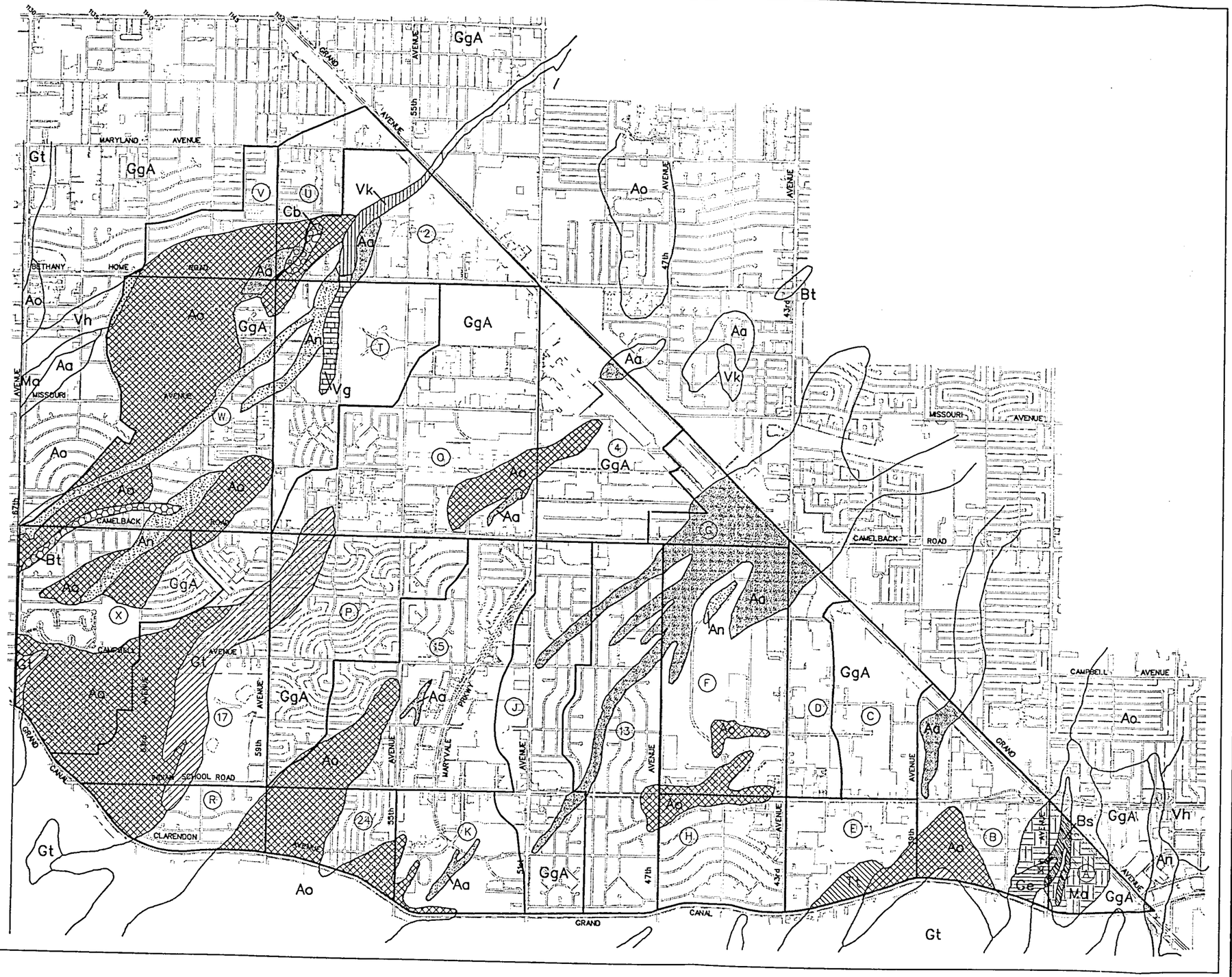
JOB NO. 950024



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF
MARYVALE
FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

SOIL CLASSIFICATION MAP

PLATE 3

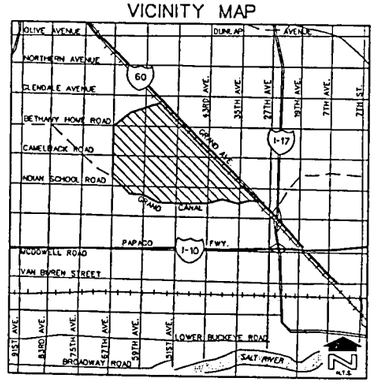
LEGEND

- Drainage Basin Boundary
- (17) Drainage Basin Number
- Aa Soil Unit Boundary

SOIL NAME

Ao	Agualt Loam
Aa	Avondale Clay Loam
An	Avonda Clay Loam
Bs	Brios Sandy Loam
Bt	Brios Loam
Cb	Carrizo Gravelly Sandy Loam
Ge	Gilman Loam, 0-1 Percent Slope
Gga	Gilman Fine Sandy Loam
Gt	Glenbar Clay Loam
Ma	Maripo Sandy Loam
Tt	Trix Clay Loam
Vg	Vint Loamy Fine Sand
Vh	Vint Fine Sandy Loam
Vk	Vint Loam

VICINITY MAP



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SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

SHEET OF

JOB NO. 950024

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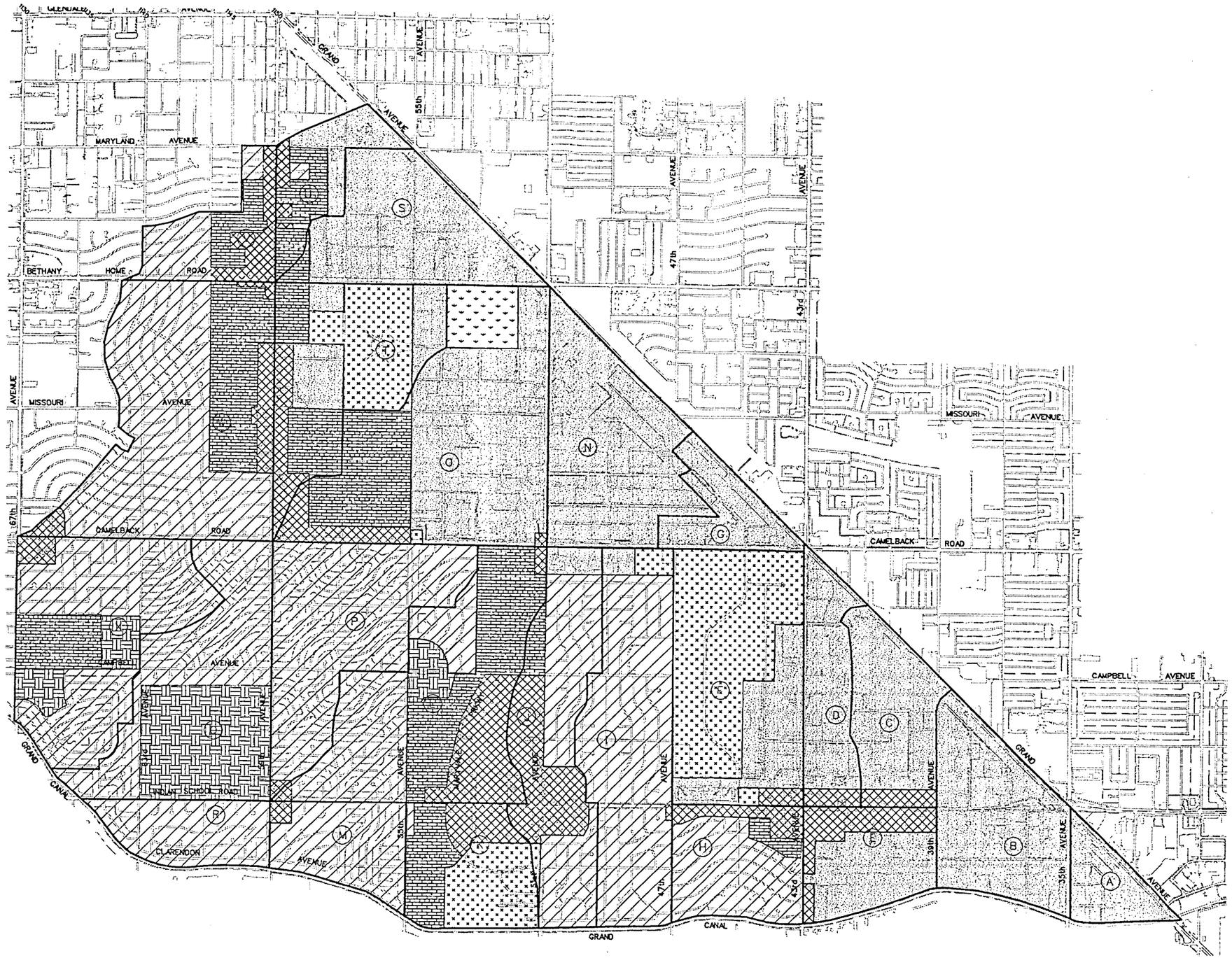


FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF MARYVALE FLOODING MITIGATION PROJECT

F.C.D. CONTRACT NO. 93-94

LAND USE MAP

PLATE 4

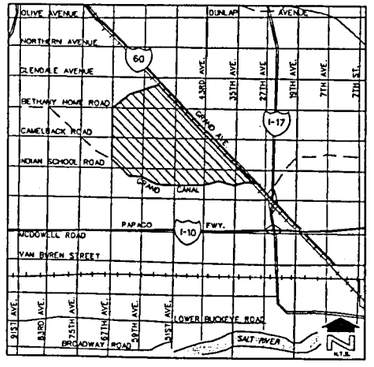
LEGEND

- Drainage Basin Boundary
- (24) Drainage Basin Number

LAND USE

- Single Family Residential
- Industrial
- Commercial
- Multi-Family Residential
- Open Space
- Park
- Row Crops

VICINITY MAP



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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

SHEET OF

JOB NO. 950024

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

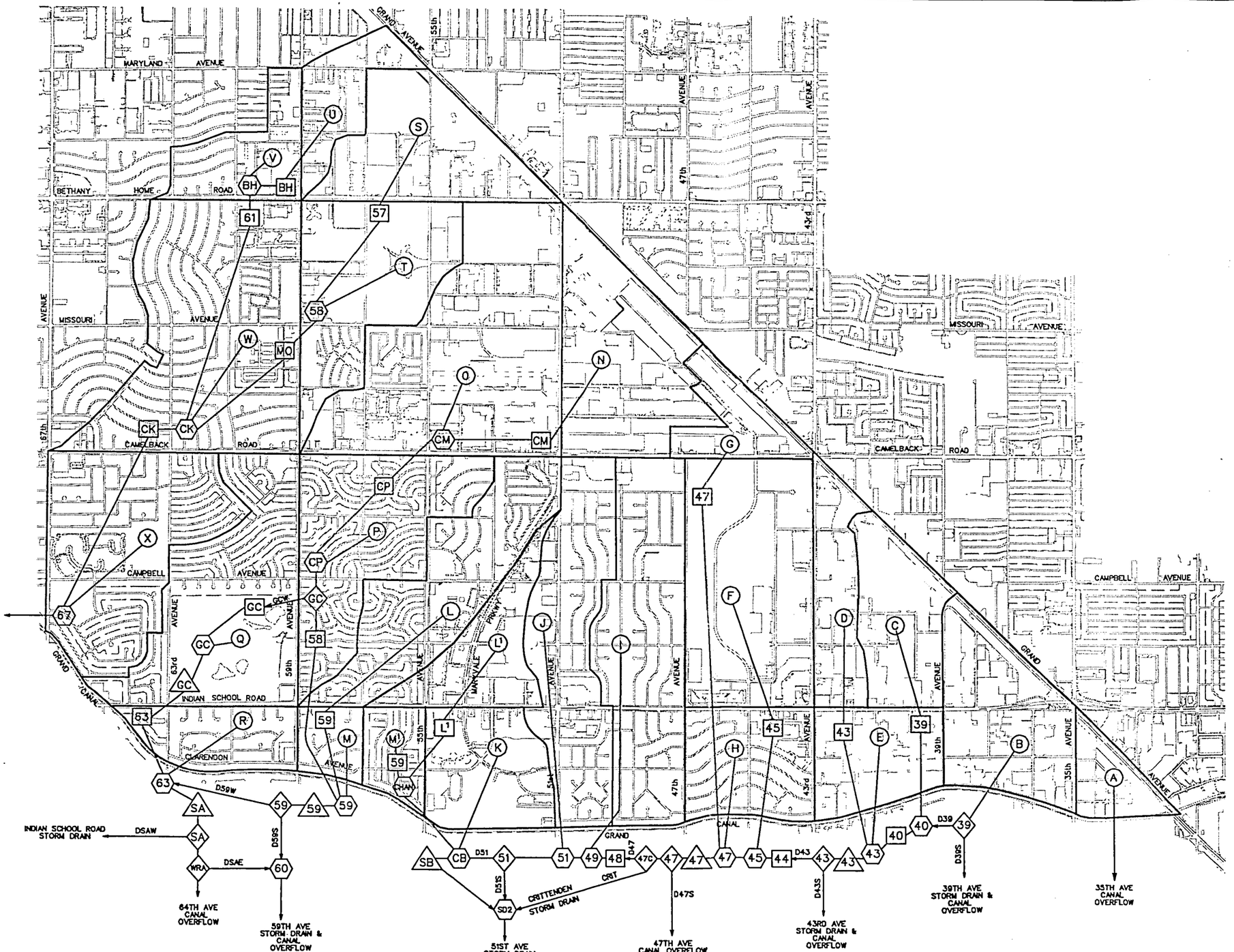
FLOOD DELINEATION STUDY OF

MARYVALE FLOODING MITIGATION PROJECT

F.C.D. CONTRACT NO. 93-94

PROPOSED HEC-1 SCHEMATIC

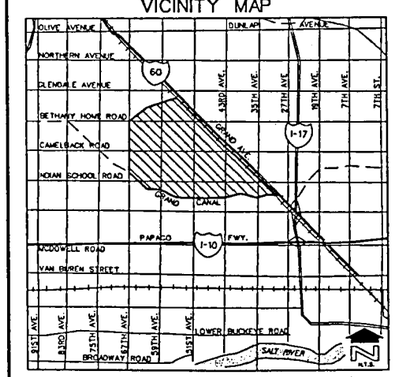
PLATE 5



LEGEND

- Drainage Basin Boundary
- Compute Runoff from Sub-Basin (T)
- Route Hydrograph (R57)
- Compute Runoff from Sub-Basin (S)
- Combine Hydrographs (C58)
- Divide Hydrograph (D59)
- D59S Divert South
- Route Hydrograph through Storage (S39)

VICINITY MAP



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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

SHEET OF

JOB NO. 950024

TABLE 1

*** O U T P U T D A T A ***

REVISED JUNE 1988 TO UPDATE COMPUTATION OF SHORT-DURATION VALUES

PRECIPITATION FREQUENCY VALUES FOR MARYVALE MITIGATION
PRIMARY ZONE NUMBER= 7
SHORT-DURATION ZONE NUMBER= 8

OPTION NUMBER 2 --- INPUT OF 12 PRECIP VALUES
LATITUDE 33.50N LONGITUDE 112.20W

POINT VALUES

RETURN PERIOD

DURATION	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR	500-YR	
5-MIN	.33	.42	.49	.58	.65	.72	.89	5-MIN
10-MIN	.49	.64	.74	.88	1.00	1.11	1.36	10-MIN
15-MIN	.60	.80	.93	1.12	1.27	1.42	1.76	15-MIN
30-MIN	.79	1.07	1.26	1.52	1.72	1.92	2.39	30-MIN
1-HR	.97	1.32	1.56	1.89	2.15	2.40	3.00	1-HR
2-HR	1.03	1.43	1.69	2.06	2.34	2.62	3.28	2-HR
3-HR	1.08	1.50	1.78	2.17	2.47	2.77	3.46	3-HR
6-HR	1.17	1.64	1.95	2.38	2.72	3.05	3.82	6-HR
12-HR	1.24	1.77	2.13	2.61	2.99	3.36	4.22	12-HR
24-HR	1.32	1.91	2.30	2.84	3.26	3.67	4.63	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=MARYVALE MITIGATION
ONE= 7 SHORT-DURATION ZONE= 8
ATITUDE= 33.50 LONGITUDE= 112.20 ELEVATION= 0
12-VALUE PRECIPITATION OPTION
PRECIPITATION VALUE:

1.15	1.65
1.95	2.37
2.78	3.00
1.35	1.92
2.29	2.79
3.19	3.77

* * * * E N D O F R U N * * * *

APPENDIX II
HYDRAULIC COMPUTATIONS

CHANNEL ROUTING DATA

ROUTE NUMBER	MANNINGS n	NUMBER OF STREETS	FLOW WIDTH (FT)	TOP ELEV.	BOTTOM ELEV.	LENGTH (FT)	SLOPE (%)
39	0.020	1	60	14.0	7.2	1600	0.43
40	0.050	N/A	20	7.2	6.8	2700	0.015
43	0.020	1	120	15.0	7.0	2150	0.37
44	0.025	1	60	7.0	4.5	1300	0.19
45	0.020	1	65	13.0	4.5	2200	0.39
47	0.025	1	90	36.3	4.8	7350	0.43
48	0.030	1	70	4.8	4.0	2650	0.030
55	0.030	2	100	2.0	0.5	2600	0.058
59	0.025	3	220	6.0	0.5	2600	0.21
CM	0.025	1	110	33.0	26.5	2600	0.25
CP	0.025	4	280	26.6	12.9	5200	0.26
GC	0.035	N/A	120	12.9	0.4	4600	0.27
63	0.025	2	110	100.4	97.5	1450	0.20
57	0.025	3	170	43.2	28.4	5200	0.28
MO	0.020	5	300	28.4	13.8	5200	0.28
BH	0.020	1	80	37.5	32.8	1330	0.35
61	0.025	6	325	32.8	13.8	4200	0.45
CK	0.025	5	300	113.8	99.0	6300	0.23

SUBBASIN	AREA sq.mi.	LENGTH miles	Kb	SLOPE ft/mile	IA inches	DTHETA	PSIF	XKSAT	RTIMP %	10-YEAR 6-HOUR FLOW (CFS)	50-YEAR 6-HOUR FLOW (CFS)	100-YEAR 6-HOUR FLOW (CFS)	100-YEAR 24-HOUR FLOW (CFS)	100-YR, 6-HR CSM VALUE
A	0.095	0.473	0.029	14.80	0.150	0.250	4.30	0.620	55.00	114	172	198	137	2084
B	0.294	1.030	0.026	16.50	0.150	0.250	5.67	0.279	55.00	305	454	520	365	1769
C	0.209	0.926	0.027	22.80	0.145	0.250	3.50	0.392	57.63	235	347	396	277	1895
D	0.168	0.971	0.027	21.60	0.146	0.250	3.50	0.391	57.23	169	251	287	201	1708
E	0.197	0.784	0.027	11.40	0.132	0.250	5.98	0.274	64.01	216	317	360	254	1827
F	0.500	1.181	0.041	20.70	0.111	0.345	4.74	0.234	11.55	337	555	650	450	1300
G	0.121	0.799	0.028	3.00	0.150	0.250	3.55	0.403	55.00	64	97	111	78	917
H	0.217	1.035	0.027	8.20	0.233	0.250	4.74	0.309	37.47	60	94	110	78	507
I	0.445	1.462	0.025	15.00	0.241	0.254	3.81	0.343	29.76	307	489	569	394	1279
J	0.388	1.599	0.026	12.30	0.200	0.252	3.50	0.378	44.87	238	365	421	293	1085
K	0.217	0.750	0.035	12.30	0.153	0.290	4.43	0.304	41.20	195	300	346	243	1594
L	0.541	1.984	0.024	14.00	0.217	0.250	5.36	0.285	45.93	322	495	571	403	1055
M	0.172	0.644	0.027	15.20	0.235	0.150	8.05	0.117	34.94	226	333	379	272	2203
N	0.383	1.124	0.025	12.20	0.150	0.250	4.43	0.341	55.00	364	543	622	435	1624
O	0.658	1.294	0.030	15.70	0.202	0.225	4.74	0.329	49.42	565	860	988	719	1502
P	0.397	1.370	0.025	17.90	0.250	0.250	5.05	0.288	30.00	300	476	554	384	1395
Q	0.475	1.376	0.050	15.30	0.230	0.250	6.29	0.259	17.75	192	322	381	265	802
R	0.179	0.742	0.027	11.40	0.250	0.150	7.78	0.130	30.00	191	287	328	234	1832
S	0.300	0.705	0.026	20.60	0.150	0.250	4.43	0.341	55.00	437	646	736	516	2453
T	0.361	0.966	0.025	15.30	0.157	0.250	4.43	0.342	56.39	412	612	699	488	1936
U	0.130	0.956	0.028	15.20	0.198	0.250	4.43	0.332	51.46	103	155	177	125	1362
V	0.172	0.712	0.027	12.90	0.208	0.150	7.50	0.152	48.05	203	298	339	241	1971
W	0.656	1.473	0.024	16.10	0.241	0.150	8.28	0.102	36.06	631	939	1071	792	1633
X	0.469	1.174	0.025	12.70	0.246	0.150	7.78	0.130	34.31	471	708	809	573	1725

MARYVALE FLOODING MITIGATION PROJECT
STORAGE VOLUME COMPUTATION

FCD 93-34
Location: 39th Ave

Prepared by: PH
Date: 6/19/95

Contour Elev. (ft) SE	Contour Area (Ac)	Average Area (Ac)	Inc. Vol (Acre-ft)	Cum Vol (Acre-ft) SV	Storm Drain			Road Weir	Canal Weir	Total	Diversion South
					Size (")	Storm Slope	Outflow (cfs)	Outflow (cfs)	Outflow (cfs)	Outflow (cfs) SO, DI	Outflow (cfs) DO
1107	.23				78	0.005%	84				84
1109	14.75										84

Remarks:

72" crosses Grand Ave. - Slope = 0.005 FT/FT, Q = 348 cfs

78" capacity = 432 cfs Excess capacity = 84 cfs

MARYVALE FLOODING MITIGATION PROJECT
STORAGE VOLUME COMPUTATION

FCD 93-34
Location: 43rd Ave

Prepared by: PH
Date: 6/16/95

Contour Elev. (ft) SE	Contour Area (Ac)	Average Area (Ac)	Inc. Vol (Acre-ft)	Cum Vol (Acre-ft) SV	Storm Drain			Road Weir	Canal Weir	Total	Diversion South
					Size (")	Storm Slope	Outflow (cfs)	Outflow (cfs)	Outflow (cfs)	Outflow (cfs) SQ, DI	Outflow (cfs) DQ
1104	0				63	.004%	27	0	0	27	27
1105	.05	.025	.025	0				0	0	27	27
1106	1.19	.62	.62	.645				0	0	27	27
1106.8	9.11*	5.15	4.12	4.77				0	0	27	27
1107	11.09	10.10	2.02	6.79				27	0	54	27
1107.2								149	0	176	27
1107.4								394	0	421	27
1108	34.84	22.97	22.97	29.76				1788	0	1815	27

Remarks:

* By linear interpolation.

60" crosses Grand Ave. - Slope = 0.004 FT/FT , Q = 191 cfs

63" capacity = 218 cfs Excess capacity = 27 cfs

MARYVALE FLOODING MITIGATION PROJECT
STORAGE VOLUME COMPUTATION

FCD 93-34
Location: 47TH Ave.

Prepared by: PH
Date: 6/19/95

Contour Elev. (ft) SE	Contour Area (Ac)	Average Area (Ac)	Inc. Vol (Acre-ft)	Cum Vol (Acre-ft) SV	Storm Drain			Road Weir	Canal Weir	Total	Diversion South
					Size (")	Storm Slope	Outflow (cfs)	Outflow (cfs)	Outflow (cfs)	Outflow (cfs) SQ, DI	Outflow (cfs) DQ
1104	0	0	0	0	48	0.004%	105	0	0	105	0
1104.8	10.10*	5.05	4.04	4.04	48	0.004%	105	10	0	115	0
1105	12.62	11.36	2.27	6.31	48	0.004%	105	55	22	182	22
1106	32.24	22.43	22.43	28.74	48	0.004%	105	1058	825	1988	825

Remarks:

* Linear interpolation

MARYVALE FLOODING MITIGATION PROJECT
STORAGE VOLUME COMPUTATION

FCD 93-34
Location: 51ST Ave.

Prepared by: PH
Date: 6/19/95

Contour Elev. (ft) SE	Contour Area (Ac)	Average Area (Ac)	Inc. Vol (Acre-ft)	Cum Vol (Acre-ft) SV	Storm Drain			Road Weir	Canal Weir	Total	Diversion South
					Size (")	Storm Slope	Outflow (cfs)	Outflow (cfs)	Outflow (cfs)	Outflow (cfs) SQ, DI	Outflow (cfs) DQ
1103	0.18				72	0.004%	312	0	0	312	312
1104	9.44	4.81	4.81	4.81	72	0.004%	312	4	0	316	316
1105	27.54	18.49	18.49	23.30	72	0.004%	312	337	567	1216	879
1106	41.31	34.43	34.43	57.73	72	0.004%	312	1870	1900	4082	2212

Remarks:

MARYVALE FLOODING MITIGATION PROJECT
STORAGE VOLUME COMPUTATION

FCD 93-34
Location: 55TH Ave.

Prepared by: PH
Date: 6/19/95

Contour Elev. (ft) SE	Contour Area (Ac)	Average Area (Ac)	Inc. Vol (Acre-ft)	Cum Vol (Acre-ft) SV	Storm Drain			Road Weir	Canal Weir	Total	Diversion South
					Size (")	Storm Slope	Outflow (cfs)	Outflow (cfs)	Outflow (cfs)	Outflow (cfs) SQ, DI	Outflow (cfs) DQ
1100	0				42	0.004%	74	0	0	74	0
1100.7	0.10*	0.05	0.04	0.04	42	0.004%	74	3	0	77	0
1101	0.14	0.12	0.04	0.08	42	0.004%	74	39	0	113	0
1102	10.82	5.48	5.48	5.56	42	0.004%	74	1101	0	1175	0
1102.5	15.23*	13.03	6.52	12.08	42	0.004%	74	2268	134	2476	134
1103	19.64	17.44	8.72	20.80	42	0.004%	74	3868	505	4447	505

Remarks:

* Linear interpolation

MARYVALE FLOODING MITIGATION PROJECT
STORAGE VOLUME COMPUTATION

FCD 93-34
Location: 59TH Ave.

Prepared by: PH
Date: 6/19/95

Contour Elev. (ft) SE	Contour Area (Ac)	Average Area (Ac)	Inc. Vol (Acre-ft)	Cum Vol (Acre-ft) SV	Storm Drain			Road Weir	Canal Weir	Total	Diversion South
					Size (")	Storm Slope	Outflow (cfs)	Outflow (cfs)	Outflow (cfs)	Outflow (cfs) SQ, DI	Outflow (cfs) DQ
99	0				72	0.003%	220**	0	0	220	272
1100	4.62	2.31	2.31	2.31	72	0.003%	220	0	0	220	272
1100.8	17.14*	10.88	7.62	9.93	72	0.003%	220	47	0	267	272
1101	22.50	19.82	5.95	15.88	72	0.003%	220	158	0	378	272
1102	38.63	30.57	30.57	46.45	72	0.003%	220	1659	810	2689	1030

Remarks:

* Linear interpolation

** The flow capacity of the 72" pipe exiting at 59TH Ave. is 272 cfs. The 42" pipe from the west has a flow capacity of 52 cfs. The flow diversion is then 220 cfs.

MARYVALE FLOODING MITIGATION PROJECT
STORAGE VOLUME COMPUTATION

FCD 93-34
Location: Indian School & Grand Canal

Prepared by: PH
Date: 6/19/95

Contour Elev. (ft) SE	Contour Area (Ac)	Average Area (Ac)	Inc. Vol (Acre-ft)	Cum Vol (Acre-ft) SV	Storm Drain			Road Weir	Canal Weir	Total	Diversion South
					Size (")	Storm Slope	Outflow (cfs)	Outflow (cfs)	Outflow (cfs)	Outflow (cfs) SQ, DI	Outflow (cfs) DQ
97	5.38				42	0.002%	52**	0	1220	1272	1220
97.2	7.29*	6.34	1.27	1.27	42	0.002%	52**	0	1573	1625	1573
97.5	10.15*	8.72	2.62	3.89	42	0.002%	52**	0	2154	2206	2154
98	14.92	12.54	6.27	10.16	42	0.002%	52**	0	3248	3300	3248
99	34.17	24.55	24.55	34.71	42	0.002%	52**	0	5846	5898	5846

Remarks:

* Linear interpolation

** There are two 42" storm drains exiting this subbasin, one to the west and the other to the east and then south. The flow capacity of each is 52 cfs.

MARYVALE FLOODING MITIGATION PROJECT
STORAGE VOLUME COMPUTATION

FCD 93-34
Location: Southwest Pond IN GOLF COURSE

Prepared by: PE
Date: 6-14-95

Contour Elev. (ft)	Contour Area (Ac)	Average Area (Ac)	Inc. Vol (Acre-ft)	Cum Vol (Acre-ft)	Storm Drain			Road Weir			Canal Weir		
					Size (")	Storm Slope	Outflow (cfs)	Length (ft)	Depth (ft)	Outflow (cfs)	Length (ft)	Depth (ft)	Outflow (cfs)
1100	1.85			0	–	–	–			0	–	–	–
1101	2.00	1.93	1.93	1.93						0			
1102	2.34	2.17	2.17	4.10						0			
1103	3.16	2.75	2.75	6.85						0			
1103.5	3.91	3.54	1.77	8.62						0			
1104	4.65	4.28	2.14	10.76						0			
1105				20.86				150	1	405			
1106				28				165	2	1260			

Remarks:

$Q = CLH^{3/2}$, $C = 2.7$

The retention basin was assumed to be at its normal water level.

MARYVALE FLOODING MITIGATION PROJECT
STORAGE VOLUME COMPUTATION

FCD 93-34
Location: Northeast Pond IN GOLF COURSE

Prepared by: PE
Date: 6-14-95

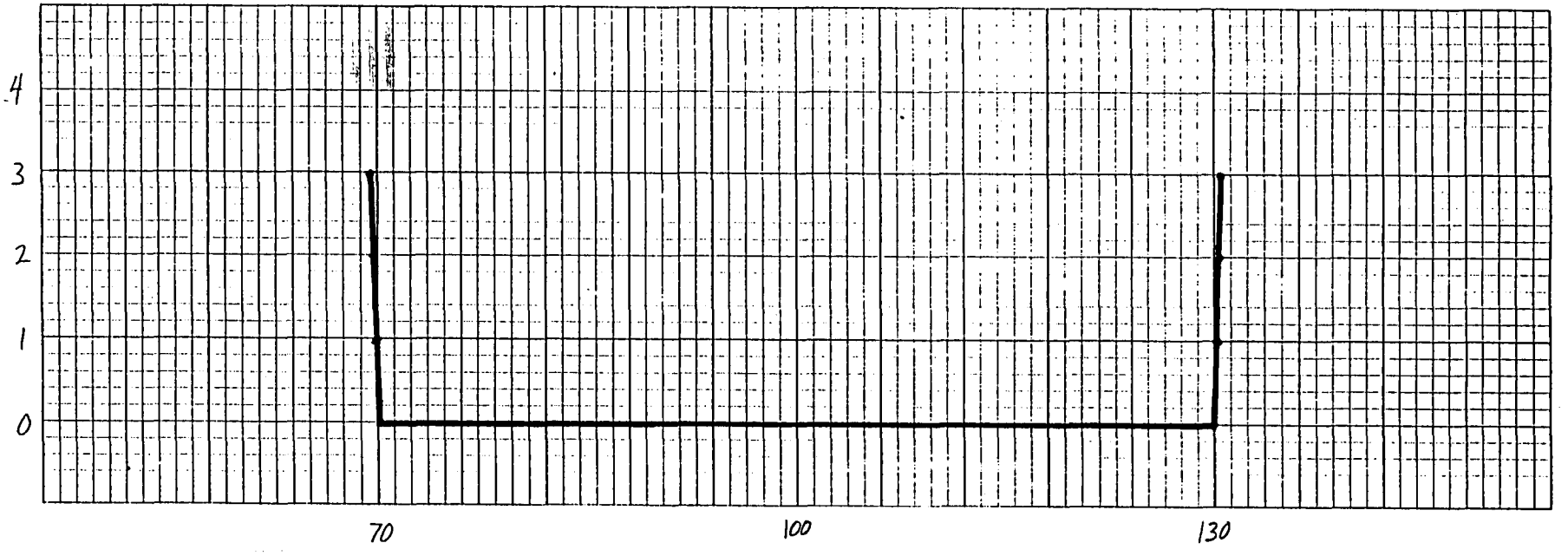
Contour Elev. (ft)	Contour Area (Ac)	Average Area (Ac)	Inc. Vol (Acre-ft)	Cum Vol (Acre-ft)	Storm Drain			Road Weir			Canal Weir		
					Size (")	Storm Slope	Outflow (cfs)	Length (ft)	Depth (ft)	Outflow (cfs)	Length (ft)	Depth (ft)	Outflow (cfs)
					–	–	–				–	–	–
1101	1.09				–	–	–			0	–	–	–
1102	1.20	1.15	1.15	1.15	–	–	–			0	–	–	–
1103	1.33	1.27	1.27	2.42	–	–	–			0	–	–	–
1104	1.57	1.45	1.45	3.87	–	–	–			0	–	–	–
1104.5	1.98	1.78	.89	4.76	–	–	–			0	–	–	–
1105	2.39	2.19	1.10	5.86	–	–	–	75	0.5	72	–	–	–
1106					–	–	–	215	1.5	1066	–	–	–

Remarks:

The retention basin was assumed to be at its normal water level.

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R39



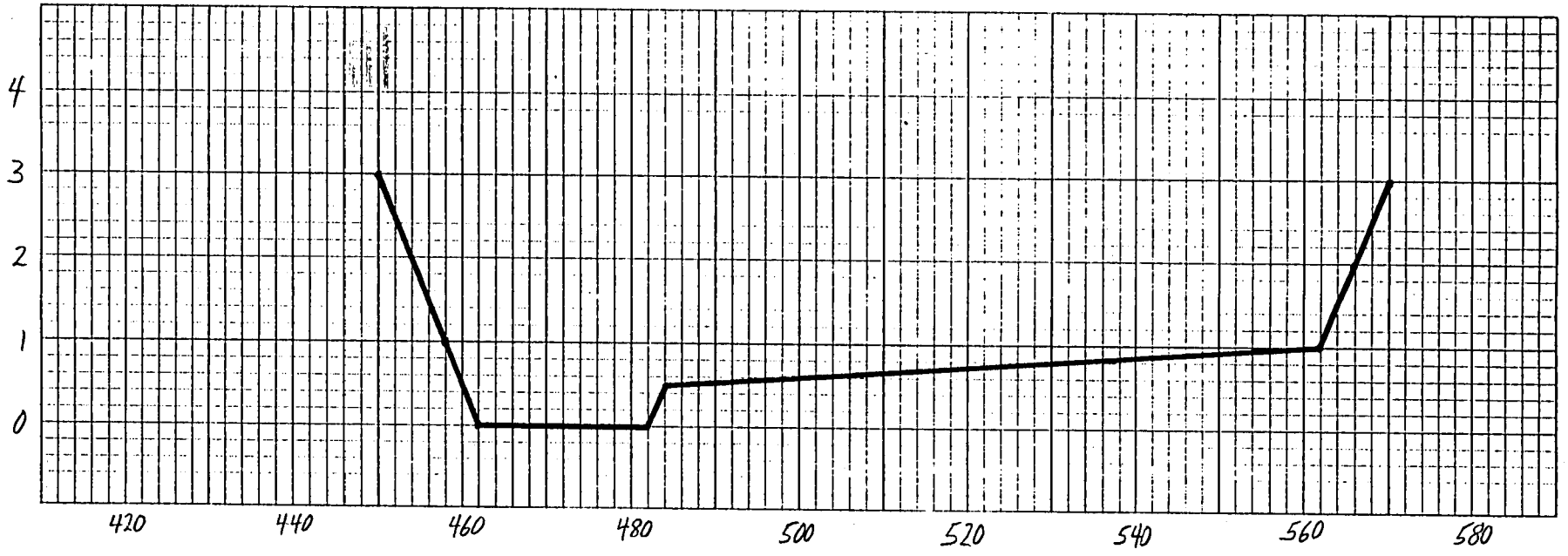
RS	16	Elev.	0					
RC	.025	0.016	.025	1600	.0042			
RX	69.7	69.8	69.9	70.0	130.0	130.1	130.2	130.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

1 street, 60' flow width

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R 40



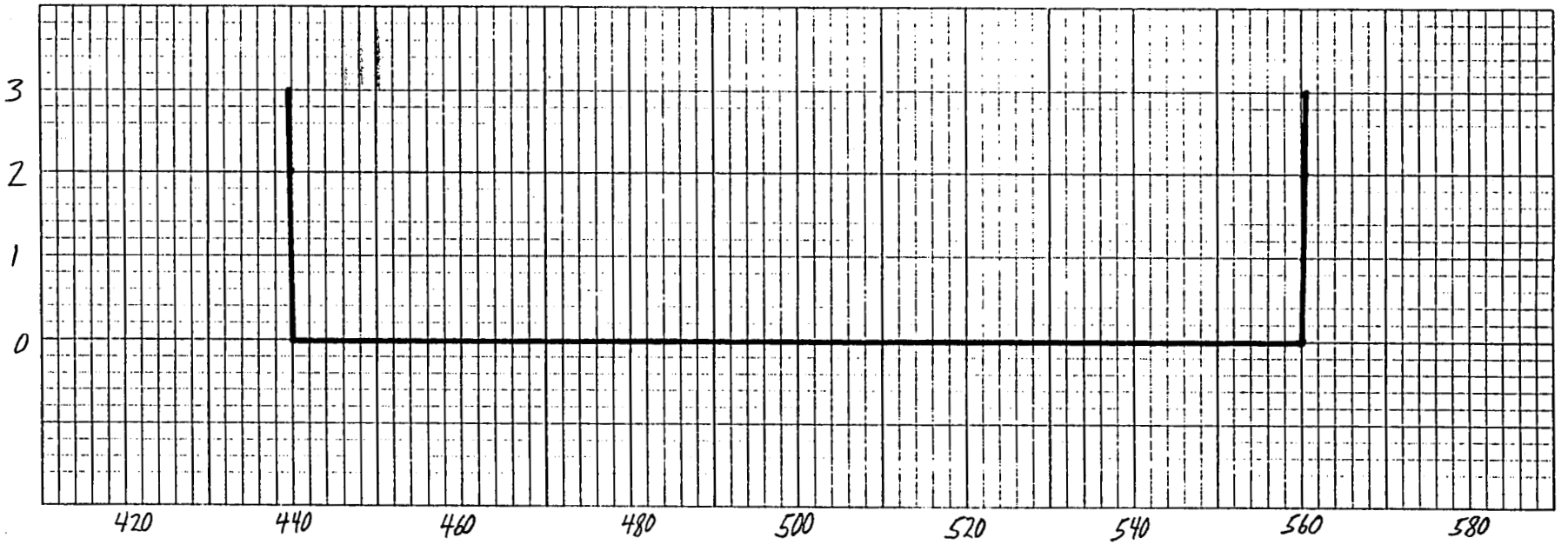
RS	27	Elev	0					
RC	0.050	0.035	0.050	2700	.0001			
RX	450	458	462	482	484	562	566	570
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

Channel adjacent to canal

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R43



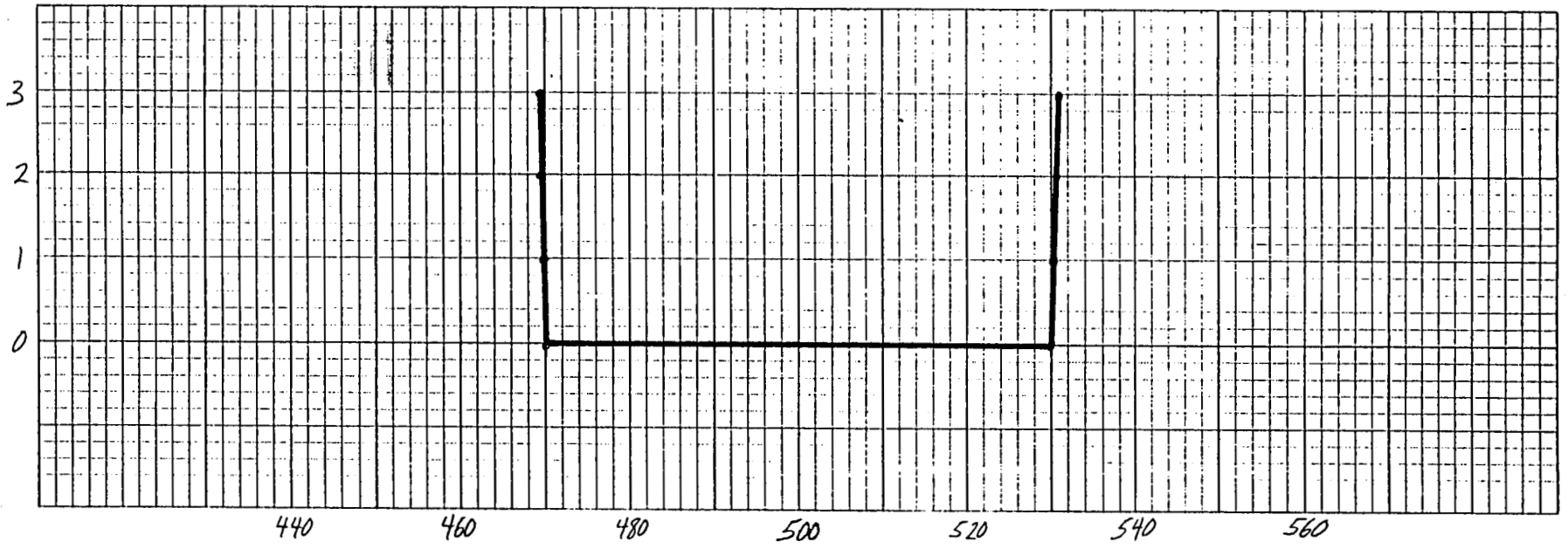
RS	22	Elev	0					
RC	0.020	0.016	0.020	2150	.0037			
RX	439.7	439.8	439.9	440	560	560.1	560.2	560.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

1 street, 120' flow width

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R44



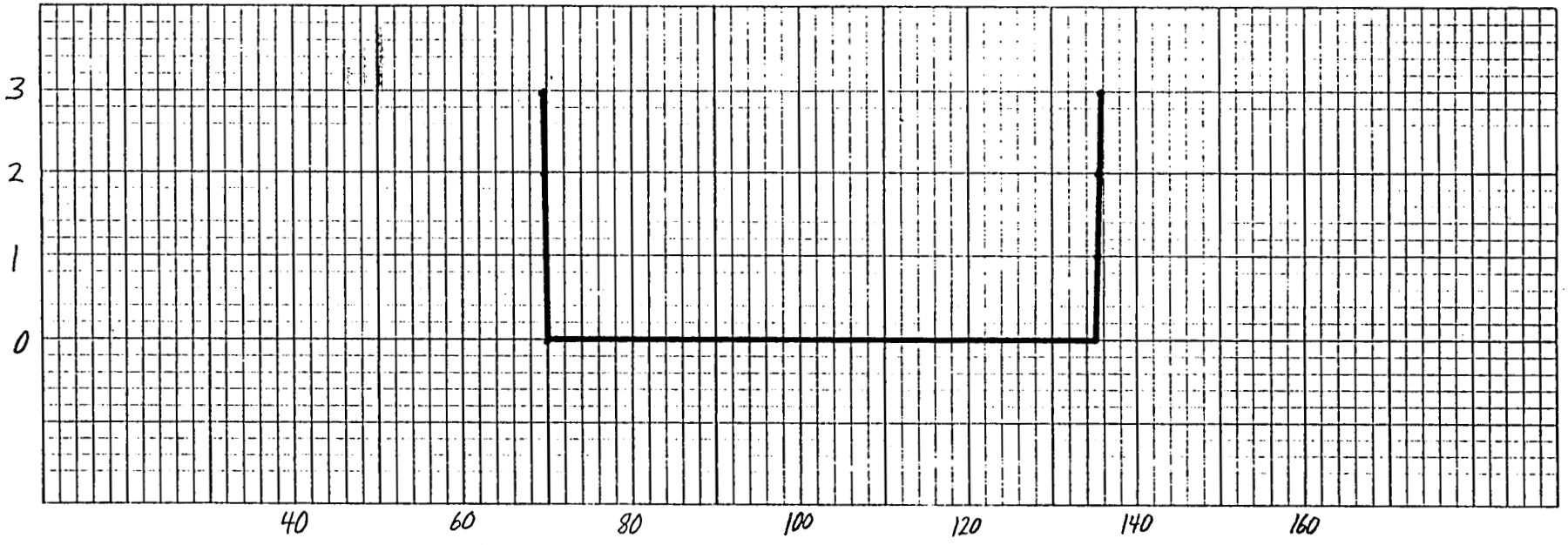
RS	13	Elev	0					
RC	0.025	0.016	0.025	1300	0.0027			
RX	469.7	469.8	469.9	470	530	530.1	530.2	530.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

1 street, 60' flow width

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R45



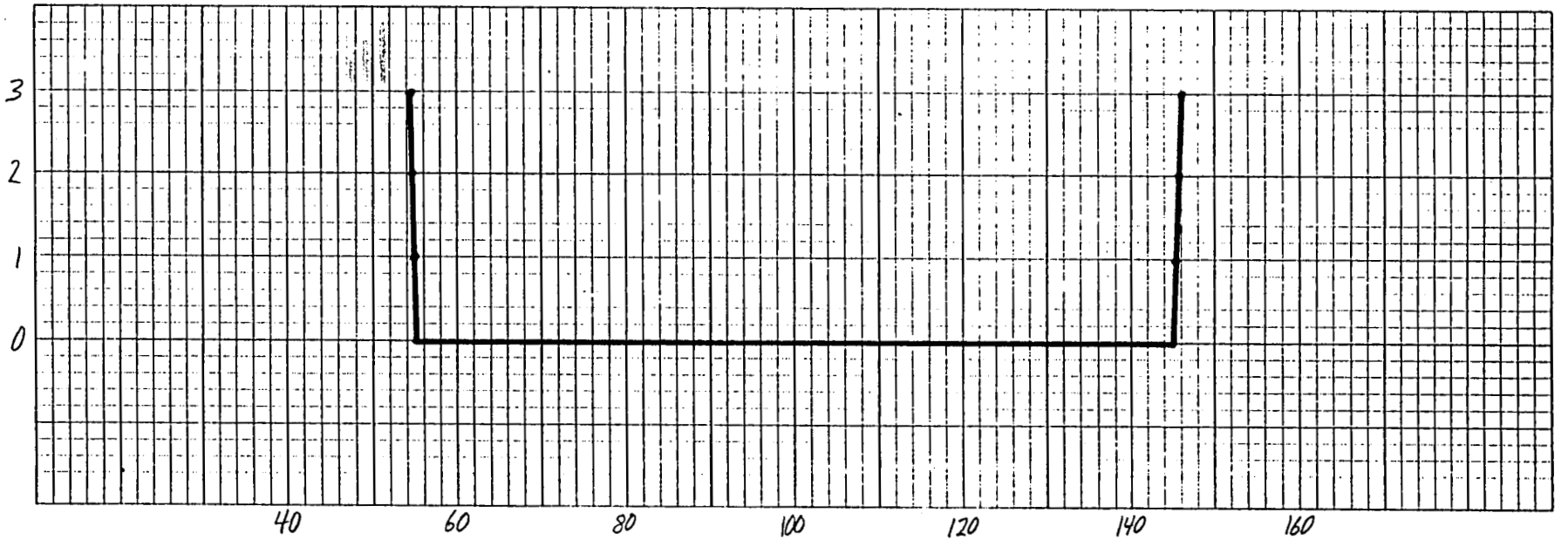
RS	22	Elev	0					
RC	0.020	0.016	0.020	2200	0.0039			
RX	69.7	69.8	69.9	70	135	135.1	135.2	135.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

1 street, 65' flow width

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R47



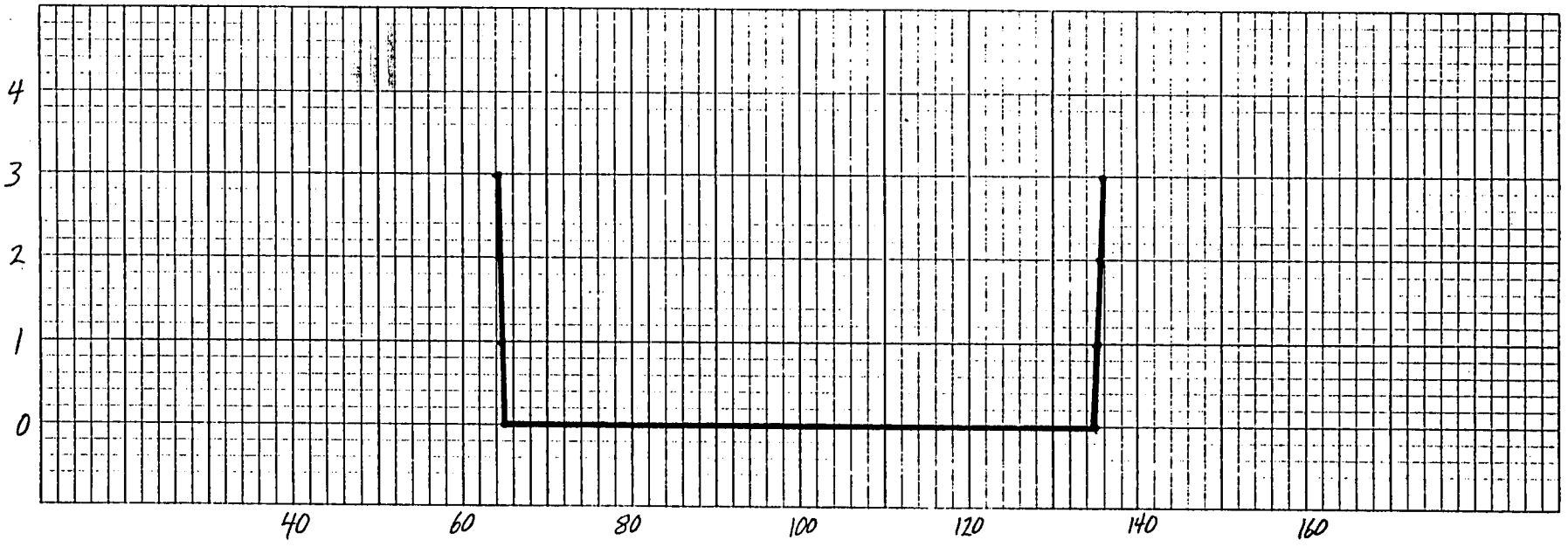
RS	74	Elev	0					
RC	0.025	0.016	0.025	7350	0.0043			
RX	54.7	54.8	54.9	55	145	145.1	145.2	145.3
RY	5	4	3	2	2	3	4	5

CALCULATED BY: PMH

1 street, 90' flow width

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R48



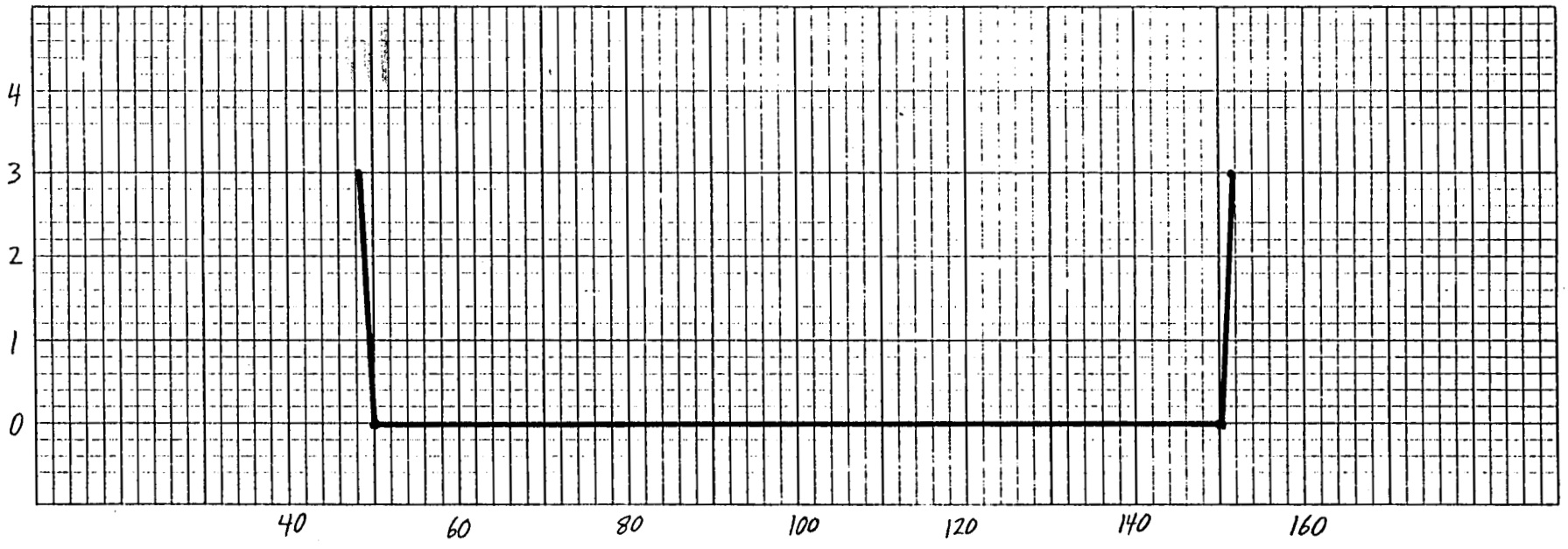
RS	27	Elev	0					
RC	0.030	0.016	0.030	2650	0.0003			
RX	64.7	64.8	64.9	65	135	135.1	135.2	135.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

1 street, 70' flow width

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R55



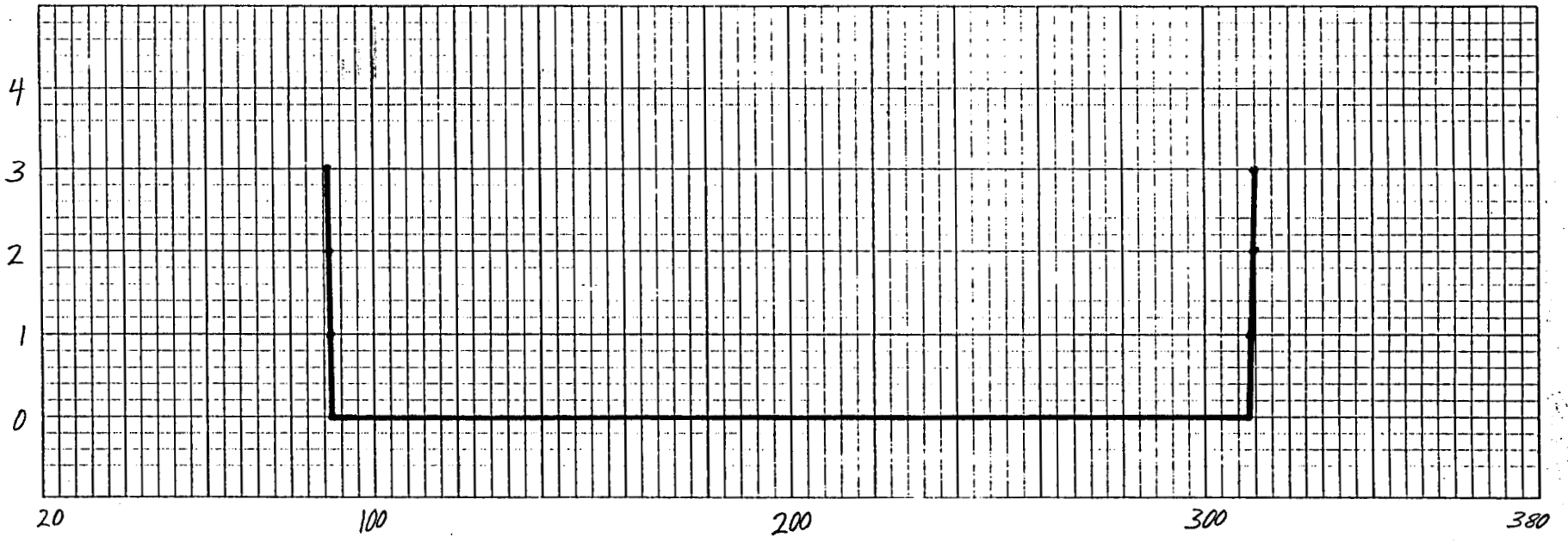
RS	26	Elev	0					
RC	0.030	0.016	0.030	2600	0.0006			
RX	49.7	49.8	49.9	50	150	150.1	150.2	150.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

2 streets, 100' flow width

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R59



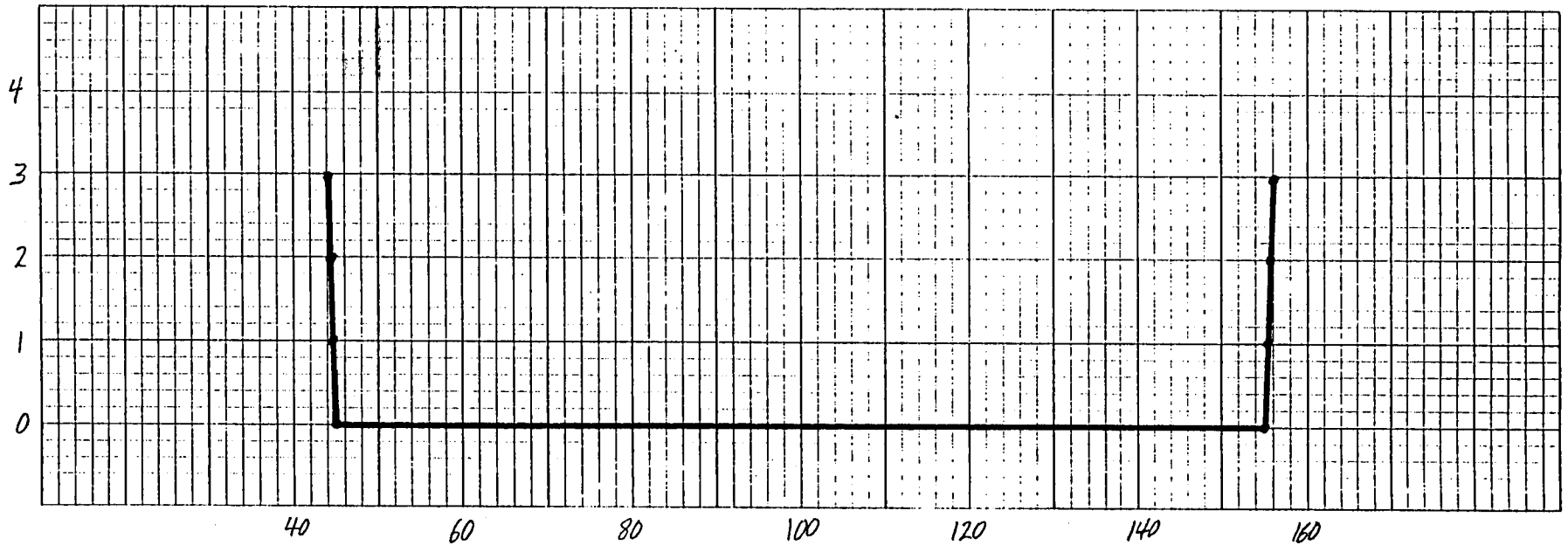
RS	26	Elev	0					
RC	0.025	0.016	0.025	2600	0.0021			
RX	89.7	89.8	89.9	90	310	310.1	310.2	310.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

3 streets, 220' flow width.

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER RCM



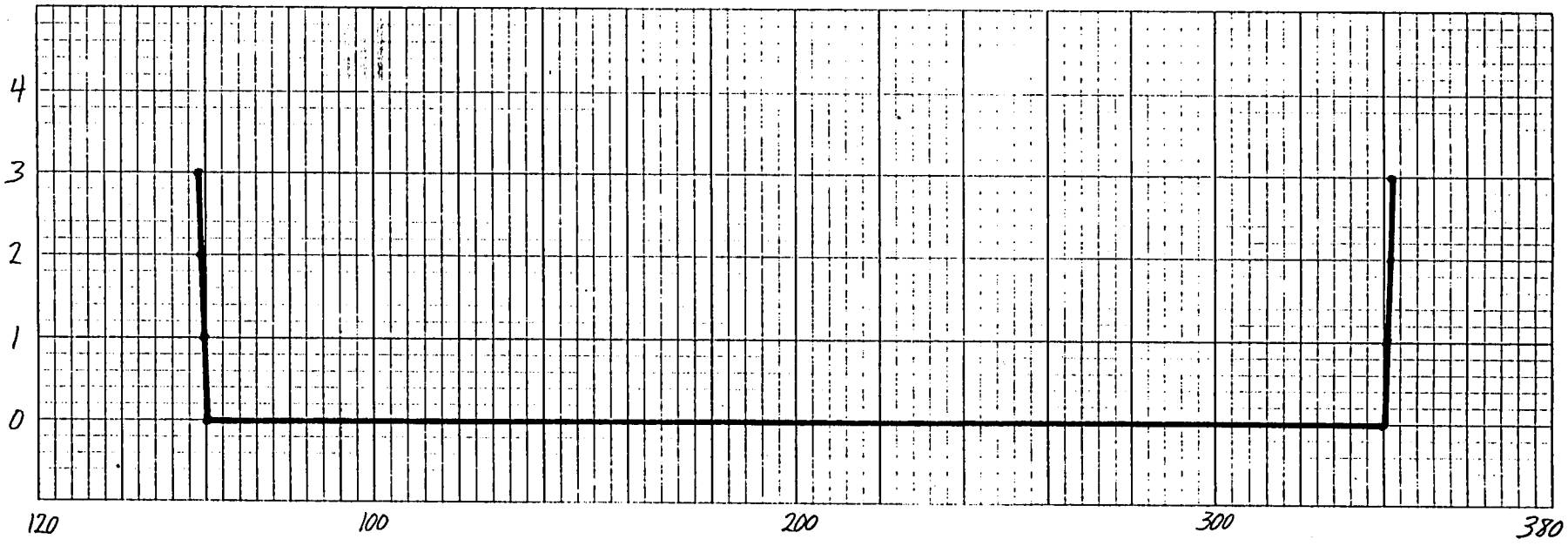
RS	26	Elev	0					
RC	0.025	0.016	0.025	2600	0.0025			
RX	44.7	44.8	44.9	45	155	155.1	155.2	155.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

1 street, 110' flow width

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER RCP



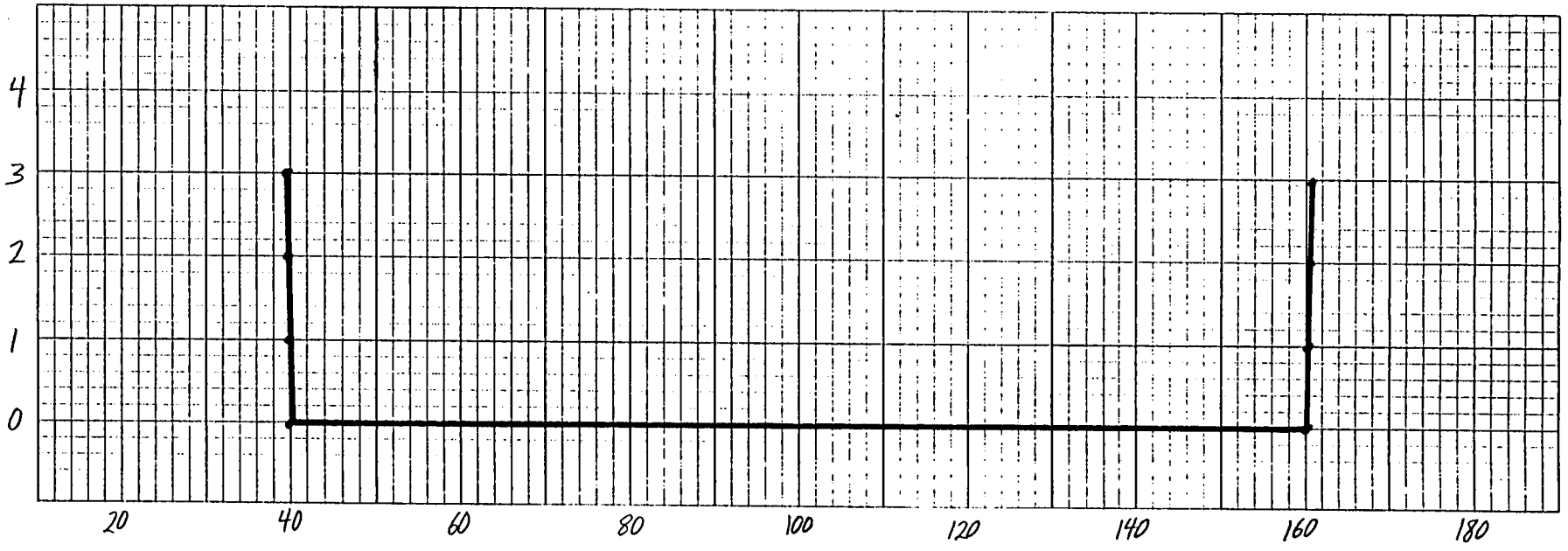
RS	52	Elev	0					
RC	0.025	0.016	0.025	5200	0.0026			
RX	159.7	159.8	159.9	160	340	340.1	340.2	340.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

4 streets, 280' flow width.

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER RGC



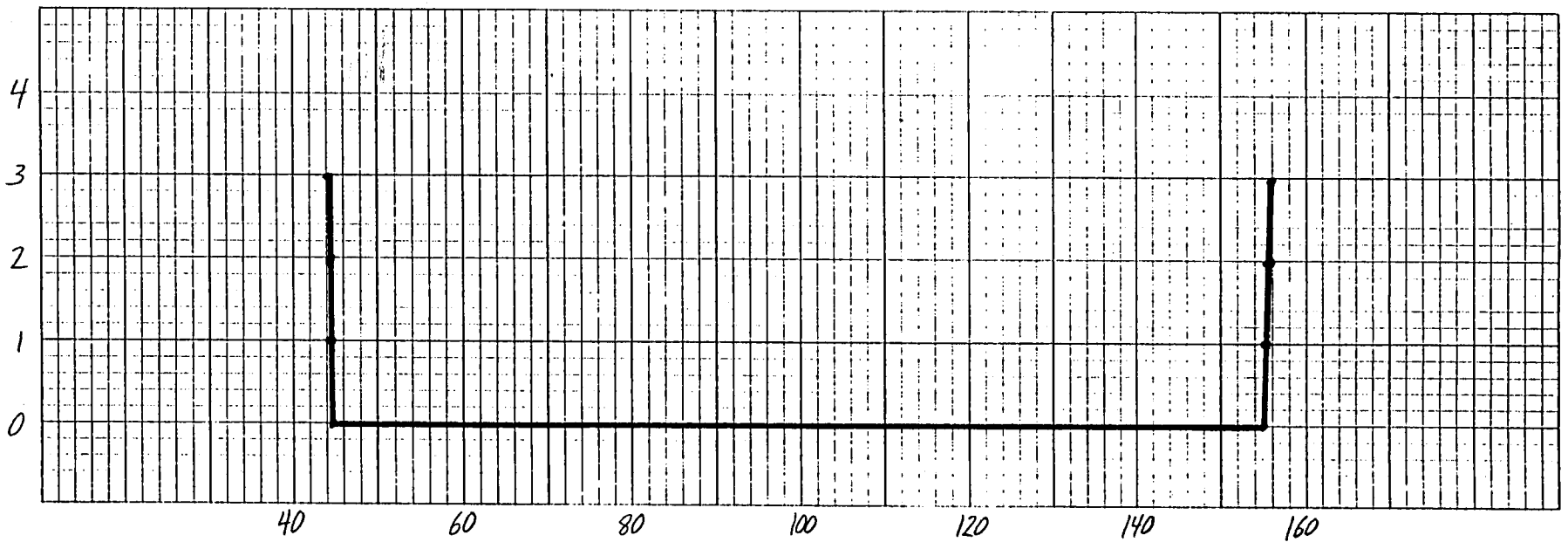
RS	46	Elev	0					
RC	0.035	0.035	0.035	4600	0.0027			
RX	39.7	39.8	39.9	40	160	160.1	160.2	160.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

Channel through golf course.

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R63



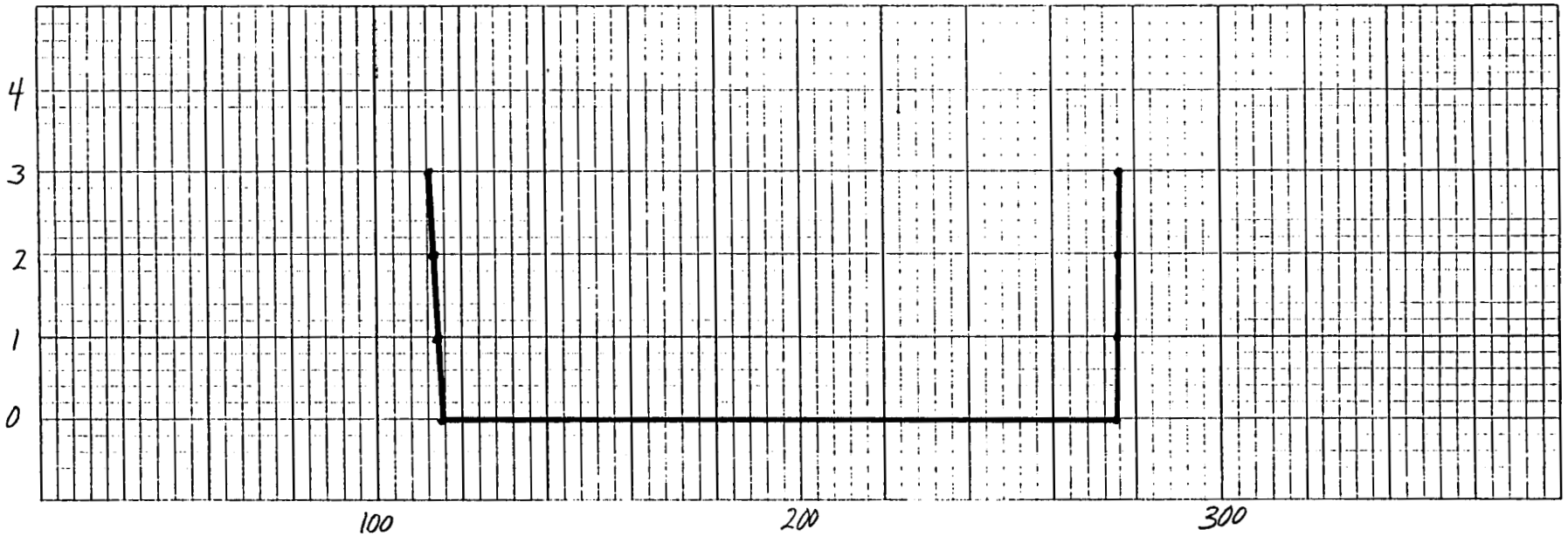
RS	15	Elev.	0					
RC	0.025	0.016	0.025	1450	0.0020			
RX	44.7	44.8	44.9	45	155	155.1	155.2	155.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

2 streets, 110' flow width

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R57



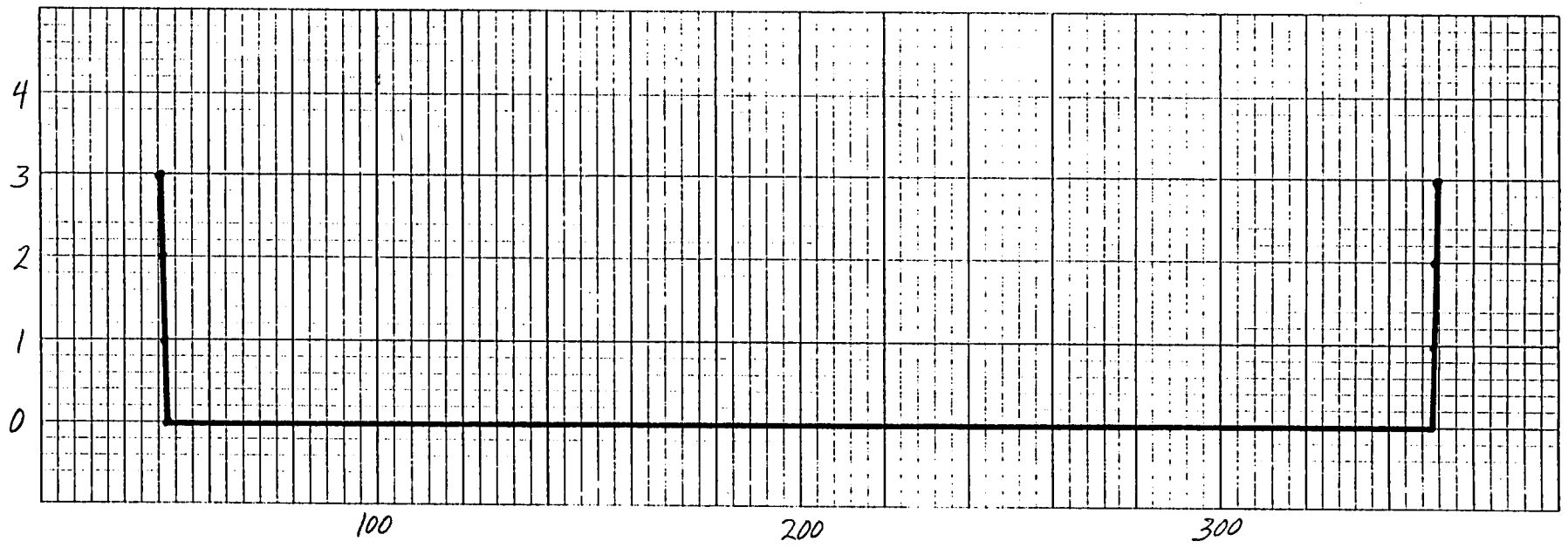
RS	52	Elev	0					
RC	0.025	0.016	0.026	5200	0.0028			
RX	114.7	114.8	114.9	115	285	285.1	285.2	285.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

3 streets, 170' flow width

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER RM0



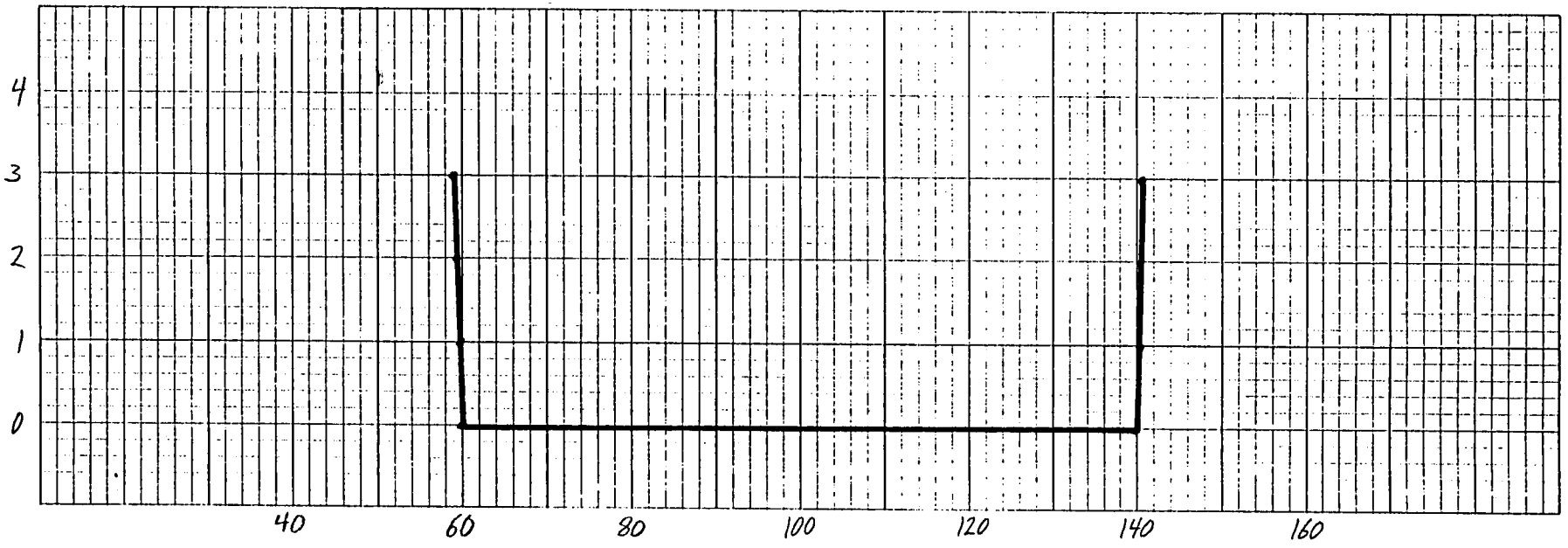
RS	52	Elev	0					
RC	0.020	0.016	0.020	5200	0.0028			
RX	49.7	49.8	49.9	50	350	350.1	350.2	350.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

5 streets, 300' flow width

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER RBH



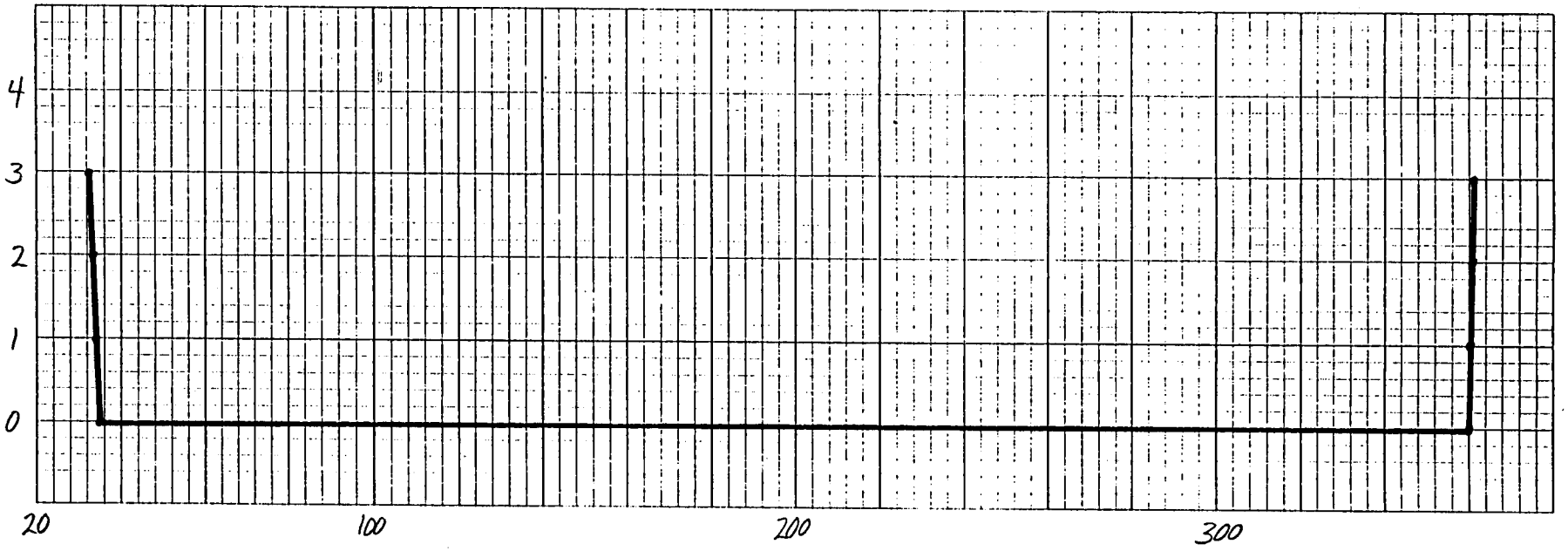
RS	13	Elev	0					
RC	0.020	0.016	0.020	1330	0.0035			
RX	59.7	59.8	59.9	60	140	140.1	140.2	140.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

1 street, 80' flow width

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER R61



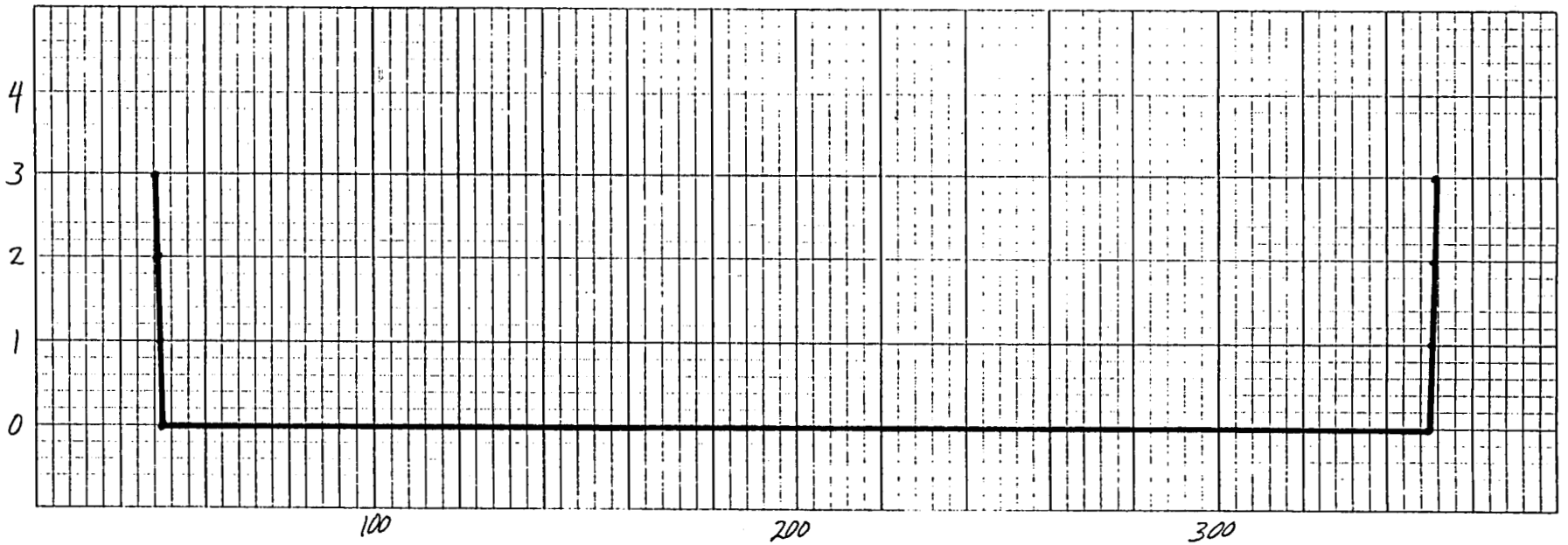
RS	42	Elev	0					
RC	0.025	0.016	0.025	4200	0.0045			
RX	34.7	34.8	34.9	35	360	360.1	360.2	360.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

6 streets, 325' flow width

NORMAL DEPTH CHANNEL ROUTE
COMPUTATION SHEET

ROUTE IDENTIFICATION NUMBER RCK



RS	63	Elev	0					
RC	0.025	0.016	0.025	6300	0.0023			
RX	49.7	49.8	49.9	50	350	350.1	350.2	350.3
RY	3	2	1	0	0	1	2	3

CALCULATED BY: PMH

5 streets, 300' flow width

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Project Maryvale
Project No. 95-0024-01
Sheet No. 1 of 3
Calculated by PMH Date 12/26/95
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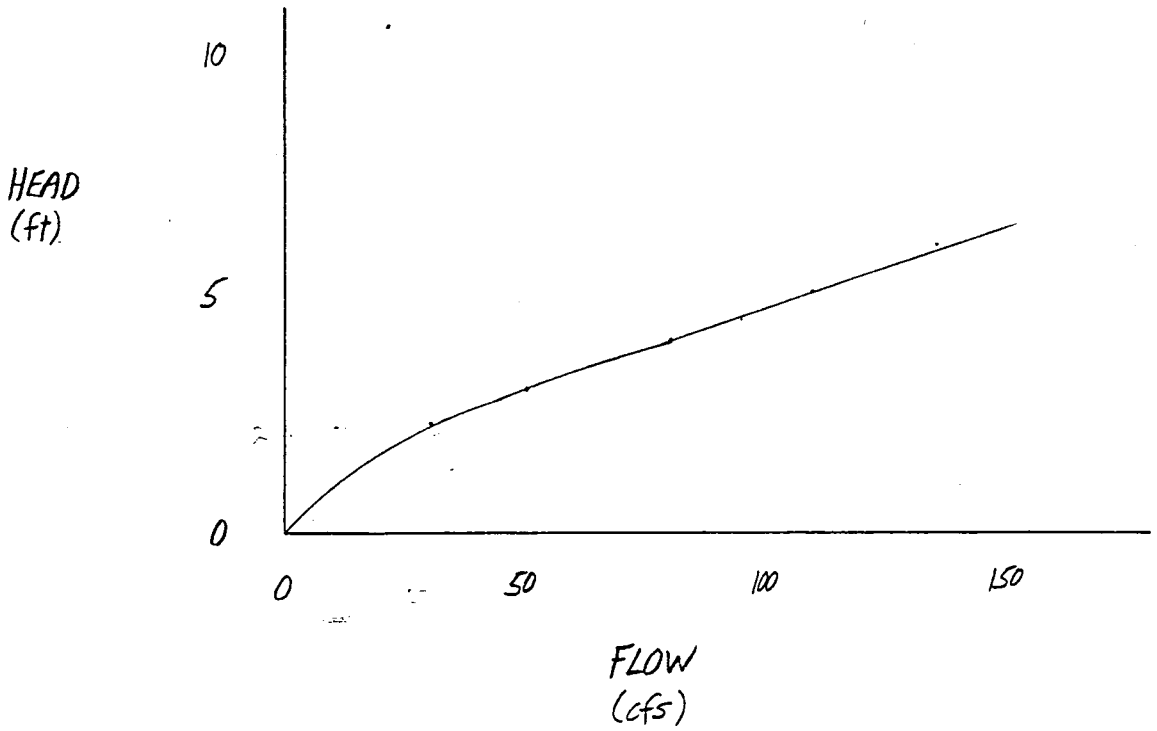
INLET CONTROL RATING CURVE
FOR 54" RGRCP OUTLET PIPE AT
DETENTION BASIN B



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LANDSCAPE ARCHITECTURE

Project Maryvale
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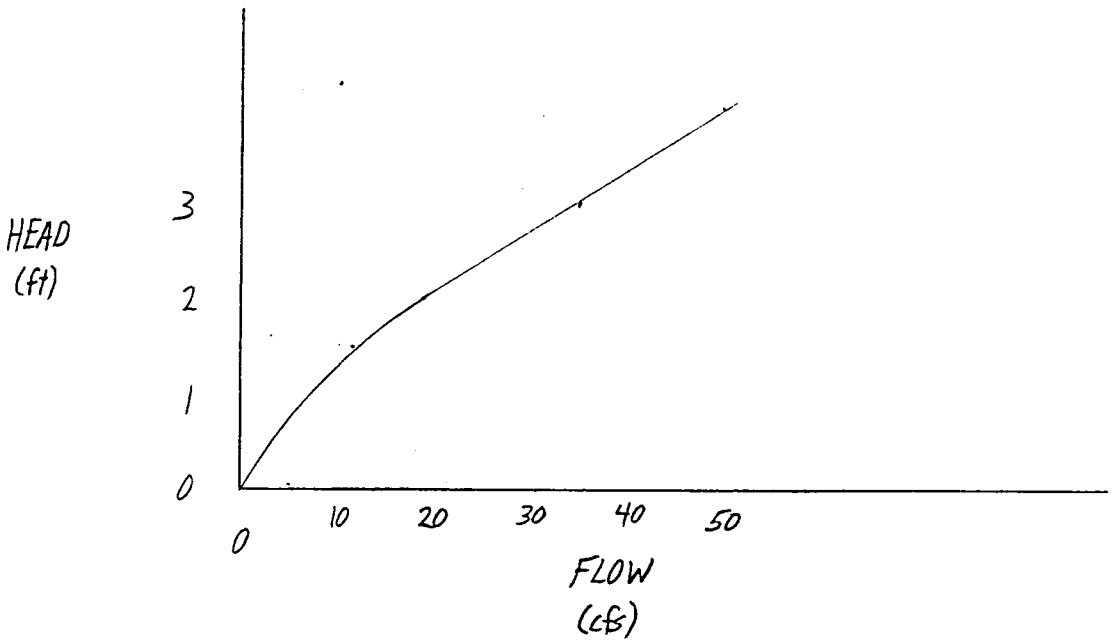
Calculated by PMH Date 12/26/95
Checked by _____ Date _____

INLET CONTROL RATING CURVE
FOR 36" RGRCP OUTLET PIPE AT
DETENTION BASIN A



Q_{FULL} = 35 cfs

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Project Maryvale
Project No. 95-0024-01
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Calculated by PMH Date 12/26/95
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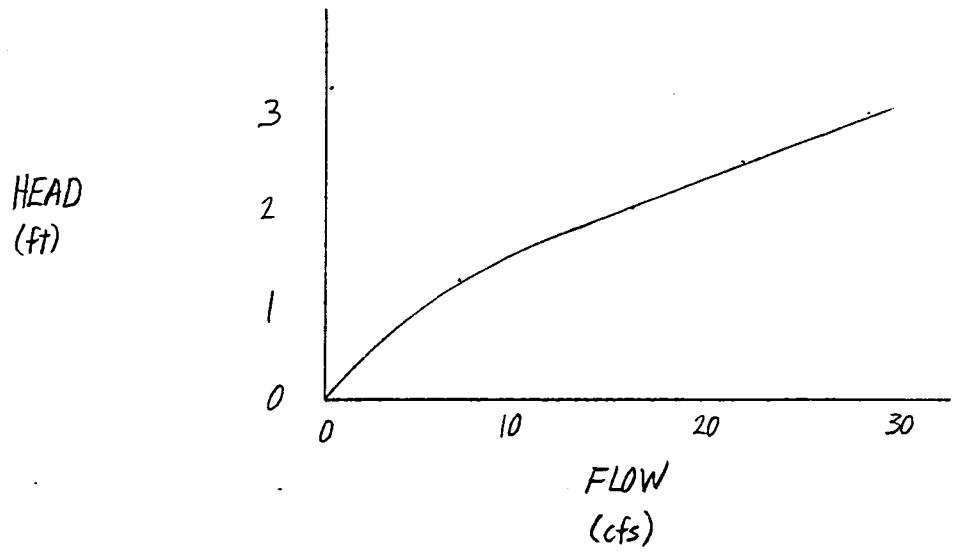
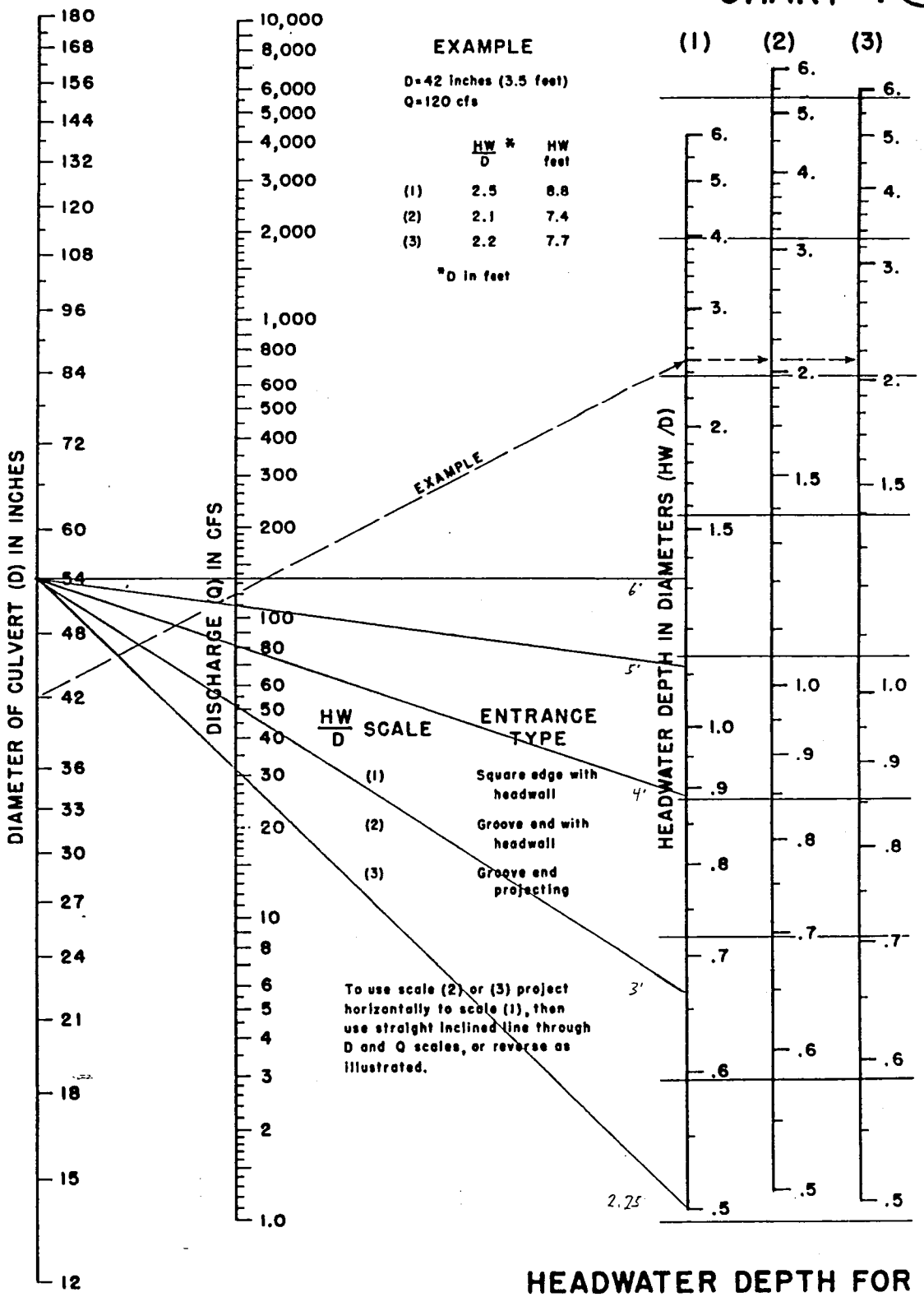
INLET CONTROL RATING CURVE
FOR 30" RGRCP OUTLET PIPE AT
DETENTION BASIN A



Q_{full} = 20 cfs

CHART 1

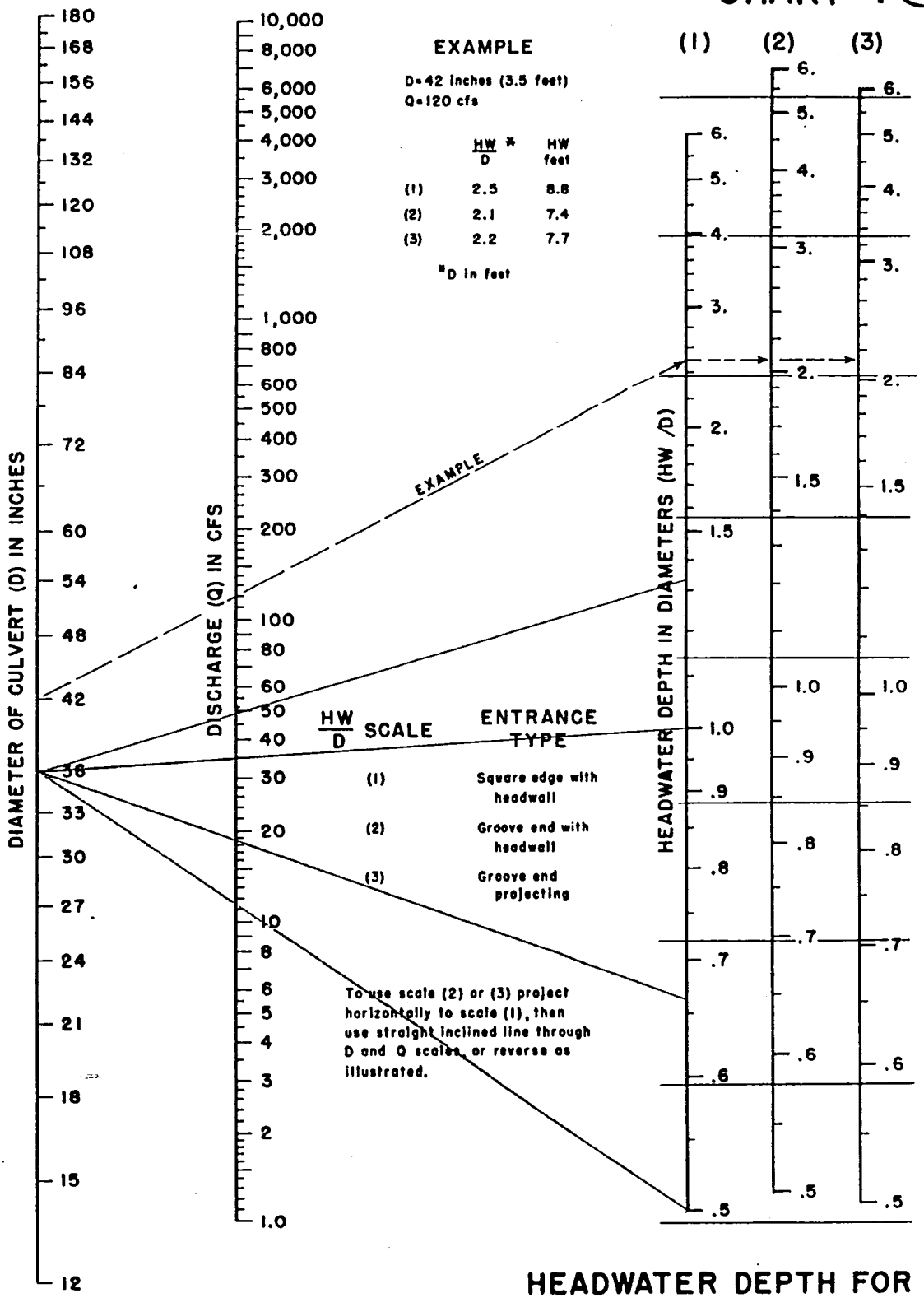


HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 283
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

CHART 1

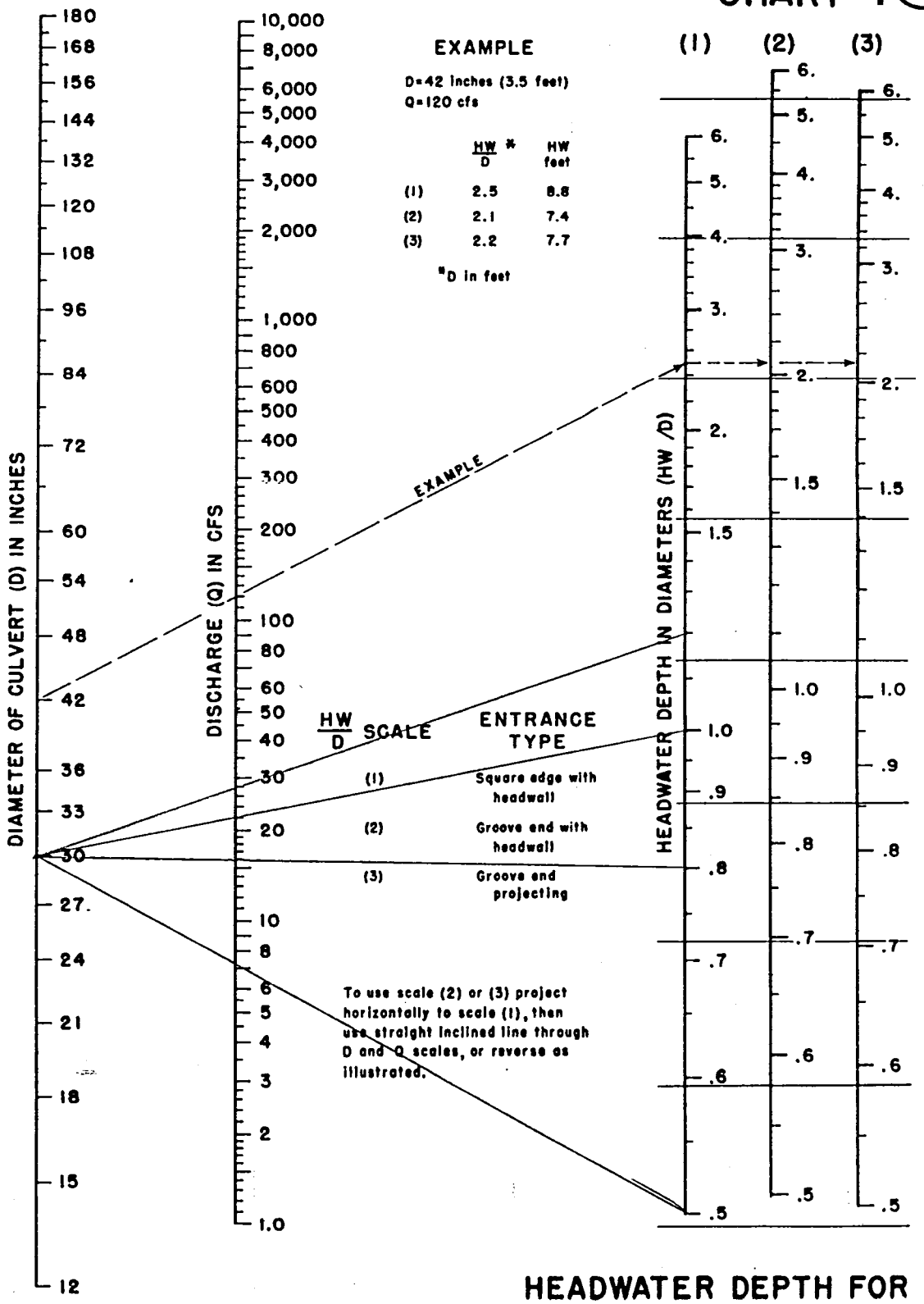


HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

CHART 1



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

24-Jan-96 Filename: pjomax-2.wk1

MARYVALE FLOODING MITIGATION PROJECT
CURB OPENING INLET SUMMARY SHEET

INPUT VARIABLES:

Pavm't x-slope, Sx (ft/ft) =	0.02	CB – Catch Basin	
1/2 Street Right-of-way width, (ft) =	40	GB – Grade Break	
Gutter width (ft.) =	1.42	HP – High Point	
Normal gutter depression, (in) =	1	LP – Low Point	
Gutter x-slope, Sw (ft/ft) =	0.059		
Normal Curb Height (in.) =	6		
C.B. gutter depression, a (in) =	2		
C.B. x-slope, S'w (ft/ft) =	0.117		
Runoff Coefficient (weighted) =	0.74		
Design storm =	100-year	Catch basin in sump design storm =	100-year
Rainfall intensity, 10 min (in/hr) =	5.5	Rainfall intensity, 10 min (in/hr) =	5.5
Clogging Factor (cont. grade) =	1.25		
Capacity per ft. of length for catch basin in sump condition (Q/L) =	1.25	(Ponding to height of back-of-sidewalk with 5" catch basin opening)	
Clogging Factor (sump) =	1.25		

Type of catch basin, reference std. detail P1569-1 from City of Phoenix Standard Details for Public Works Construction, 1992

Sta. Ref.	From Sta.	To Sta.	Length (ft.)	Total Length (ft.)	Avg. Width	R.O.W. Area (ac.)	Cum CA	Runoff (Q) (cfs)	Qb (cfs)	QT (cfs)	Slope (So) (ft/ft)	X-Slope (Sx)	Convey. (Kt)	Spread T (ft)	Flow Depth (ft)	LT (ft)	Lreq (ft)	La (ft)	Efficiency (E)	Qi (cfs)	Qb (cfs)	Interception Ratio (cfs/ft)
51ST AVENUE																						
Typical C.B.			0.00	0.00	40	0.000	0	50.00		50.00	0.00750	0.020	577.35	32.82	0.71	65.11	81.39	5.00	10.8%	5.39	44.61	1.08

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Project Maryvale
Project No. 95-0024-01
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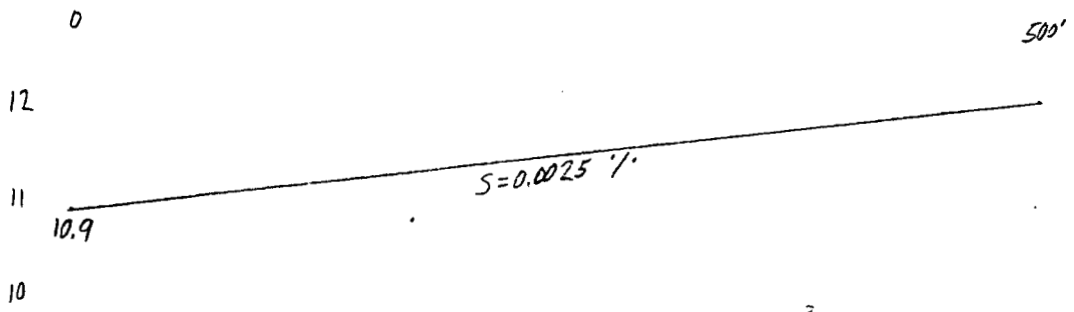
INDIAN SCHOOL ROAD

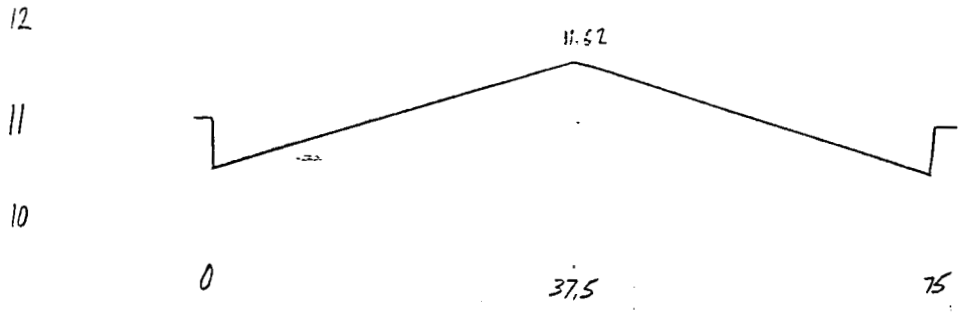
Weir flow over crown



$Q = CLH^{3/2}$

$C = 2.9$ (p.5-41, Handbook of Hydr
$L = 500'$
$H = 0.1' - 1.0'$

(ft)	H	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
(cfs)	Q	46	130	238	367	513	674	849	1038	1238	1450



SECTION A-A

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LANDSCAPE ARCHITECTURE

Project Maryvale
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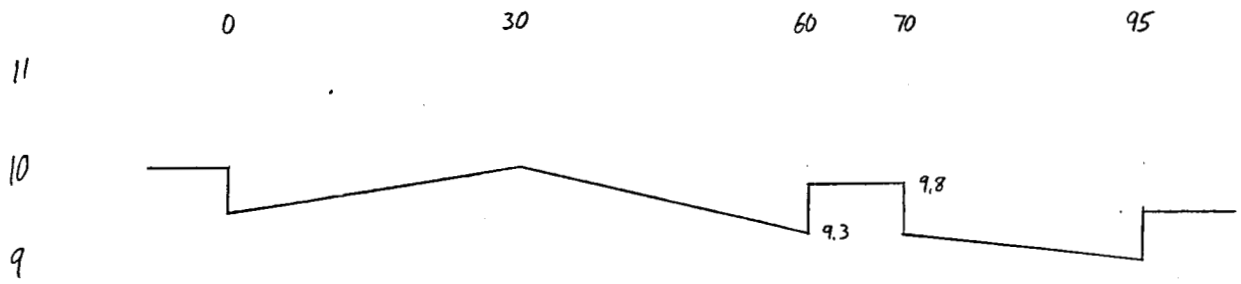
59TH AVE. CROSS-SECTION



$S = 0.0025$ FT/FT

$Q = 1758$ cfs (100-yr, 6-hr) → $D = 11.88'$
$Q = 934$ cfs (10-yr, 6-hr) → $D = 11.15'$

HORIZ.: 1" = 20'

4550 NORTH 12TH STREET • PHOENIX, ARIZONA 85014 • PHONE (602) 264-6831

MARYVALE FLOODING MITIGATION PROJECT
STORM SEWER CAPACITY CALCULATION RECORD

Input Variables

Outlet TW elev. =	1057.65
Manning's n =	0.012

51ST AVENUE STORM DRAIN SYSTEM

Outlet ID	Existing Grade	From Sta Outlet	To Sta Inlet	Storm Sewer Design Data: Outlet Inv.	Inlet Inv.	Length (ft)	So (ft/ft)	D (in.)	Q full (cfs)	Qpipe (cfs)	Head Loss Calculations: Vpipe (ft/s)	Sf (ft/ft)	hf (ft)	km	hm (ft)	Hyd. Grade Line: Elev. @ outlet	Elev. @ inlet	Depth Below Grade	Comments	Number of Catch Basins: 3'	5-6'	7'	8'	9'	13'	Inflow Rate(cfs/ft)	Inflow (cfs)
51ST AVENUE TRUNK LINE																											
I-10 Interceptor Channel																											
			716		1050.65			84		508	13.19						1057.65		Pressure Flow								
I-10 Outlet	1072.0	716	1382	1050.65	1051.79	666.00	0.0017	84	286	508	13.19	0.00538	3.58	0.3	0.81	1058.46	1062.05	13.5	Pressure Flow		1					1.08	5.9
McDowell Road																										1.08	0.0
Transition Structure	1073.0	1382	2078	1051.79	1054.78	696.00	0.0043	78	372	440	13.26	0.00600	4.17	0.1	0.27	1062.32	1066.49	10.7	Pressure Flow				1			1.08	8.6
MH	1074.5	2078	2740	1054.78	1057.68	662.00	0.0044	78	376	431	13.00	0.00576	3.82	0.1	0.27	1066.77	1070.58	7.7	Pressure Flow			2				1.08	15.1
MH	1077.0	2740	2860	1057.68	1058.10	120.00	0.0035	78	336	416	12.54	0.00537	0.64		0.00	1070.58	1071.23	6.4	Pressure Flow	1	1					1.08	9.2
Grade Break	1077.5	2860	3404	1058.10	1060.37	544.00	0.0042	78	367	407	12.26	0.00513	2.79	0.1	0.24	1071.47	1074.26	6.0	Pressure Flow			1				1.08	7.6
MH	1079.0	3404	4060	1060.37	1063.04	656.00	0.0041	78	362	399	12.04	0.00494	3.24	0.1	0.23	1074.50	1077.74	4.5	Pressure Flow							1.08	0.0
MH	1081.0	4060	4723	1063.04	1065.68	663.00	0.0040	78	358	399	12.04	0.00494	3.28	0.1	0.22	1077.97	1081.24	3.0	Pressure Flow	1	1					1.08	9.2
MH	1083.0	4723	5384	1065.68	1068.37	661.00	0.0041	78	362	390	11.76	0.00472	3.12	0.1	0.22	1081.47	1084.59	1.5	Pressure Flow		1	1				1.08	13.5
MH	1086.0	5384	5542	1068.37	1068.91	158.00	0.0034	78	332	377	11.35	0.00440	0.70		0.00	1084.59	1085.28	1.4	Pressure Flow			3				1.08	22.7
Grade Break	1086.5	5542	6044	1068.91	1071.22	502.00	0.0046	78	385	354	10.67	0.00389	1.95	0.1	0.20	1085.48	1087.43	1.0	Pressure Flow							1.08	0.0
MH	1088.5	6044	6701	1071.22	1074.07	657.00	0.0043	78	374	354	10.67	0.00389	2.55	0.3	0.53	1087.97	1090.52	0.5	Pressure Flow		1					1.08	5.9
Thomas Road																											
MH	1091.5	6701	6977	1074.07	1075.14	276.00	0.0039	72	286	303	10.71	0.00436	1.20	0.1	0.18	1090.69	1091.90	0.8	Pressure Flow		1		2			1.08	23.2
MH	1092.5	6977	7483	1075.14	1077.20	506.00	0.0041	72	293	280	9.89	0.00371	1.88	0.1	0.18	1092.07	1093.95	0.4	Pressure Flow			1	1			1.08	16.2
MH	1094.0	7483	8145	1077.20	1079.91	662.00	0.0041	72	294	263	9.31	0.00329	2.18	0.1	0.15	1094.11	1096.29	-0.1	Pressure Flow							1.08	0.0
MH	1096.5	8145	8746	1079.91	1081.99	601.00	0.0035	72	270	263	9.31	0.00329	1.98	0.1	0.13	1096.42	1098.40	0.1	Pressure Flow							1.08	0.0
MH	1098.5	8746	9405	1081.99	1083.87	659.00	0.0029	72	245	263	9.31	0.00329	2.17		0.00	1098.40	1100.57	0.1	Pressure Flow		1					1.08	5.9
Grade Break	1102.5	9405	9655	1083.87	1085.83	250.00	0.0078	72	406	257	9.10	0.00315	0.79	0.3	0.40	1100.98	1101.76	1.5	Pressure Flow		1	1				1.08	13.5
Crittenden Road																											
Transition Structure	1105.0	9655	10040	1085.83	1088.59	385.00	0.0072	72	389	186	6.58	0.00164	0.63	0.1	0.13	1101.89	1102.52	3.1	Pressure Flow							1.08	0.0
MH	1105.5	10040	12019	1088.59	1096.21	1979.00	0.0039	72	285	186	6.58	0.00164	3.25	0.3	0.20	1102.73	1105.98	2.8	Pressure Flow							1.08	0.0
Indian School Road S.D.																											
Junction	1114.0	12019	12096	1096.21	1096.27	77.00	0.0008	72	128	111	3.93	0.00059	0.05	0.1	0.07	1106.04	1106.09	8.0	Pressure Flow							1.08	0.0
MH	1114.5	12096	12352	1096.27	1098.63	256.00	0.0092	66	349	111	4.68	0.00093	0.24	0.1	0.02	1106.11	1106.35	8.4	Pressure Flow	1	1					1.08	9.2
MH	1114.5	12352	12756	1099.19	1100.65	404.30	0.0036	42	65	102	10.59	0.00875	3.54	0.1	0.03	1106.39	1109.92	8.1	Pressure Flow	2						1.08	6.5
MH	1115.5	12756	13097	1100.65	1101.87	340.70	0.0036	42	65	95	9.92	0.00767	2.61	0.1	0.17	1110.10	1112.71	5.4	Pressure Flow	1						1.08	3.2
MH	1117.0	13097	13400	1101.87	1102.97	303.00	0.0036	42	66	92	9.58	0.00716	2.17	0.1	0.15	1112.86	1115.03	4.1	Pressure Flow	1			2	2		1.08	40.0
MH	1117.5	13400	13860	1103.47	1105.13	460.00	0.0036	36	43	52	7.39	0.00523	2.41	0.1	0.14	1115.17	1117.58	2.3	Pressure Flow							1.08	0.0
MH	1119.0	13860	14300	1105.13	1106.71	440.00	0.0036	36	43	52	7.39	0.00523	2.30	0.3	0.25	1117.83	1120.14	1.2	Pressure Flow	1						1.08	3.2
Campbell S.D.																											
MH	1121.0	14300	14719	1106.71	1108.22	419.00	0.0036	24	15	9	2.87	0.00135	0.57	0.1	0.08	1120.22	1120.79	0.8	Pressure Flow		1					1.08	5.9
MH	1122.5	14719	15039	1109.22	1110.37	320.20	0.0036	24	15	3	0.98	0.00016	0.05	0.1	0.01	1120.80	1120.85	1.7	Pressure Flow							1.08	0.0
MH	1123.0	15039	15371	1110.37	1111.56	332.60	0.0036	24	15	3	0.98	0.00016	0.05	0.1	0.00	1120.85	1120.91	2.1	Pressure Flow							1.08	0.0
MH	1121.0	15371	15775	1111.56	1113.02	403.20	0.0036	24	15	3	0.98	0.00016	0.06	0.1	0.00	1120.91	1120.97	0.1	Pressure Flow							0.15	0.0
MH	1121.0	15775	16028	1113.02	1113.94	253.20	0.0036	24	15	3	0.98	0.00016	0.04	0.1	0.00	1120.97	1121.01	0.0	Pressure Flow	1	1					0.15	1.3
MH	1121.0	16028	16524	1113.94	1115.71	496.30	0.0036	24	15	2	0.57	0.00005	0.03	0.1	0.00	1121.01	1121.04	-0.0	Pressure Flow	2						0.15	0.9
MH	1121.0	16524	16750	1115.71	1116.53	225.80	0.0036	24	15	1	0.29	0.00001	0.00	0.1	0.00	1121.04	1121.04	-0.0	Pressure Flow	2						0.15	0.9

MARYVALE FLOODING MITIGATION PROJECT
STORM SEWER CAPACITY CALCULATION RECORD

Outlet ID	Existing Grade	From Sta Outlet	To Sta Inlet	Storm Sewer Design Data: Outlet inv.	Inlet inv.	Length (ft)	So (ft/ft)	D (in.)	Q full (cfs)	Qpipe (cfs)	Head Loss Calculations: Vpipe (ft/s)	Sf (ft/ft)	hf (ft)	km	hm (ft)	Hyd. Grade Line: Elev. @ outlet	Elev. @ inlet	Depth Below Grade	Comments	Number of Catch Basins: 3'	5-6"	7'	8'	9'	13'	Inflow Rate(cfs/ft)	Inflow (cfs)
LATERAL STORM DRAIN LINES																											
McDowell Road S.D.																											
			986		1053.32			36		62	8.76						1062.32		Pressure Flow							1.08	0.0
51st Ave. S.D.	1073.0	986	1075	1053.32	1055.90	89.00	0.0290	36	123	62	8.76	0.00734	0.65	0.1	0.12	1062.44	1063.09	10.6	Pressure Flow		2					1.08	11.9
MH	1073.0	1075	1500	1055.90	1056.92	425.00	0.0024	36	35	50	7.08	0.00480	2.04	0.1	0.12	1063.21	1065.25	9.8	Pressure Flow							1.08	0.0
MH	1073.0	1500	2380	1056.92	1059.03	880.00	0.0024	36	35	50	7.08	0.00480	4.22	0.1	0.08	1065.33	1069.55	7.7	Pressure Flow	1		1				1.08	10.8
MH	1074.5	2380	2820	1059.03	1060.09	440.00	0.0024	36	35	39	5.55	0.00295	1.30	0.1	0.08	1069.63	1070.92	4.9	Pressure Flow	2						1.08	6.5
MH	1075.5	2820	3253	1060.09	1061.13	433.00	0.0024	36	35	33	4.63	0.00206	0.89	0.1	0.05	1070.97	1071.86	4.5	Pressure Flow	1						1.08	3.2
MH	1074.5	3253	3335	1061.75	1062.88	82.00	0.0138	21	20	30	12.27	0.02959	2.43	0.1	0.03	1071.90	1074.32	2.6	Pressure Flow						2	1.08	28.1
MH 47th Ave.	1074.5	3335	3826	1062.88	1064.04	491.00	0.0024	21	8	1	0.60	0.00007	0.03	0.1	0.23	1074.56	1074.59	-0.1	Pressure Flow		2				1	0.06	1.4
MH	1074.5	3826	4110	1064.04	1065.18	284.00	0.0040	21	11	0	0.00	0.00000	0.00	0.1	0.00	1074.59	1074.59	-0.1	Pressure Flow							0	0.0
MH	1074.5	4110	4387	1065.18	1066.29	277.00	0.0040	21	11	0	0.00	0.00000	0.00	0.1	0.00	1074.59	1074.59	-0.1	Pressure Flow							0	0.0
MH	1074.5	4387	4664	1066.29	1067.04	277.00	0.0027	21	9	0	0.00	0.00000	0.00	0.1	0.00	1074.59	1074.59	-0.1	Pressure Flow	2						0	0.0
MH	1075.0	4664	4940	1067.04	1068.50	276.00	0.0053	21	12	0	0.00	0.00000	0.00	0.1	0.00	1074.59	1074.59	0.4	Pressure Flow		1				1	0	0.0
Thomas Road S.D.																											
			1010		1075.13			54		45	2.85						1090.69		Pressure Flow								
51st Ave. S.D.	1091.5	1010	1360.	1075.13	1075.92	350.70	0.0023	54	101	45	2.85	0.00045	0.16	0.1	0.01	1090.71	1090.87	0.8	Pressure Flow		2					1.08	11.9
MH	1091.8	1360.	1600	1075.92	1076.16	239.30	0.0010	54	67	33	2.10	0.00025	0.06	0.1	0.01	1090.88	1090.94	0.9	Pressure Flow							0.7	0.0
MH	1091.2	1600	1955.	1076.16	1076.51	355.40	0.0010	54	67	33	2.10	0.00025	0.09	0.1	0.01	1090.94	1091.03	0.3	Pressure Flow		1					0.5	2.8
MH	1092.0	1955.	2300	1077.01	1077.41	344.60	0.0012	48	53	31	2.44	0.00039	0.13	0.1	0.01	1091.04	1091.17	1.0	Pressure Flow		2					0.4	4.4
MH	1091.8	2300	2959.	1077.41	1078.81	659.85	0.0021	48	72	26	2.09	0.00029	0.19	0.1	0.01	1091.18	1091.37	0.6	Pressure Flow		1	2				0.2	3.9
MH	1092.3	2959.	3042.	1079.31	1079.44	82.40	0.0016	42	43	22	2.33	0.00042	0.03	0.1	0.01	1091.38	1091.41	0.9	Pressure Flow			2				0.2	2.8
MH	1093.3	3042.	3400	1079.94	1080.51	357.75	0.0016	36	29	20	2.77	0.00074	0.26	0.1	0.01	1091.42	1091.68	1.9	Pressure Flow		1					0.5	2.8
MH	1093.3	3400	3737	1080.51	1081.45	337.00	0.0028	36	38	17	2.38	0.00054	0.18	0.1	0.01	1091.70	1091.88	1.6	Pressure Flow				1			0.3	2.4
MH	1093.8	3737	3843	1081.45	1081.62	106.00	0.0016	36	29	14	2.04	0.00040	0.04	0.1	0.01	1091.89	1091.93	1.9	Pressure Flow		2		1			0.2	3.8
MH	1093.7	3843	4328	1081.87	1082.89	485.00	0.0021	33	26	11	1.79	0.00035	0.17	0.1	0.01	1091.94	1092.10	1.8	Pressure Flow		2					0.2	2.2
MH	1092.8	4328	4518	1083.64	1084.06	190.00	0.0022	24	12	8	2.69	0.00119	0.23	0.1	0.00	1092.11	1092.34	0.7	Pressure Flow		3	2				0.1	3.1
MH	1092.1	4518	4800	1084.31	1084.93	282.00	0.0022	21	8	5	2.24	0.00099	0.28	0.1	0.01	1092.35	1092.63	-0.2	Pressure Flow							0.1	0.0
MH	1092.8	4800	5050	1083.64	1085.73	250.00	0.0084	21	16	5	2.24	0.00099	0.25	0.1	0.01	1092.63	1092.88	0.2	Pressure Flow				1			0.2	1.6
MH	1093.3	5050	5133	1085.73	1085.94	83.00	0.0025	18	6	4	2.15	0.00112	0.09	0.1	0.01	1092.89	1092.98	0.4	Pressure Flow				1			0.2	1.6
MH	1093.3	5133	5500	1085.94	1086.75	367.00	0.0022	18	5	2	1.24	0.00037	0.14	0.1	0.01	1092.99	1093.13	0.3	Pressure Flow		2					0.2	2.2
Crittenden S.D.																											
			0		1086.45			54		58	3.65						1101.89		Pressure Flow								
51st Ave. S.D.	1105.0	0	416	1086.45	1088.50	416.00	0.0049	54	150	58	3.65	0.00074	0.31	0.1	0.02	1101.91	1102.22	3.1	Pressure Flow	2						1.08	6.5
Transition Structure	1104.0	416	1077	1088.50	1090.08	661.00	0.0024	54	104	52	3.24	0.00058	0.39	0.1	0.02	1102.24	1102.63	1.8	Pressure Flow							1.08	0.0
MH	1104.0	1077	1930	1090.08	1092.15	853.00	0.0024	54	105	52	3.24	0.00058	0.50	0.1	0.02	1102.65	1103.14	1.4	Pressure Flow	3		2	1			1.08	33.5
MH	1103.5	1930	2276	1092.15	1093.13	346.00	0.0028	54	113	18	1.13	0.00007	0.02	0.1	0.02	1103.16	1103.19	0.3	Pressure Flow								0.0
MH	1103.0	2276	2827	1092.39	1094.15	551.00	0.0032	48	88	18	1.44	0.00013	0.07	0.1	0.00	1103.19	1103.26	-0.2	Pressure Flow		1	2				0.15	2.9
MH	1104.0	2827	3841	1094.15	1096.03	1014.00	0.0019	48	67	15	1.20	0.00009	0.10	0.1	0.00	1103.26	1103.36	0.7	Pressure Flow								0.0
MH	1104.9	3841	4097	1094.40	1096.44	256.00	0.0080	42	97	15	1.57	0.00019	0.05	0.1	0.00	1103.36	1103.41	1.5	Pressure Flow			2				1.08	15.1

MARYVALE FLOODING MITIGATION PROJECT
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Outlet ID	Existing Grade	From Sta Outlet	To Sta Inlet	Storm Sewer Design Data: Outlet inv.	Inlet inv.	Length (ft)	So (ft/ft)	D (in.)	Q full (cfs)	Qpipe (cfs)	Head Loss Calculations: Vpipe (ft/s)	Sf (ft/ft)	hf (ft)	km	hm (ft)	Hyd. Grade Line: Elev. @ outlet	Elev. @ inlet	Depth Below Grade	Comments	Number of Catch Basins: 3'	5-6'	7'	8'	9'	13'	Inflow Rate(cfs/ft)	Inflow (cfs)
Indian School Road S.D.																											
			1010		1096.60			42		75	7.78						1106.04		Pressure Flow								
51st Ave. S.D.	1114.4	1010	1122	1096.60	1096.82	112.00	0.0020	42	48	75	7.78	0.00471	0.53	0.1	0.09	1106.14	1106.67	8.3	Pressure Flow	1						1.08	3.2
Transition Structure	1114.2	1122	1400	1096.82	1097.38	278.00	0.0020	42	49	72	7.44	0.00432	1.20	0.1	0.09	1106.76	1107.96	7.4	Pressure Flow							1.08	0.0
MH	1114.5	1400	1880	1097.38	1098.34	480.00	0.0020	42	49	72	7.44	0.00432	2.07	0.1	0.09	1108.04	1110.12	6.5	Pressure Flow	1	2					1.08	15.1
MH	1114.7	1880	2265	1098.34	1099.11	385.00	0.0020	42	49	56	5.87	0.00269	1.03	0.1	0.09	1110.20	1111.24	4.5	Pressure Flow		2					1.08	11.9
MH	1114.7	2265	2780	1099.11	1100.14	515.00	0.0020	42	49	45	4.63	0.00167	0.86	0.1	0.05	1111.29	1112.15	3.4	Pressure Flow	3						1.08	9.7
MH	1115.0	2780	3220	1100.14	1101.08	440.00	0.0021	42	50	35	3.62	0.00102	0.45	0.1	0.03	1112.18	1112.64	2.8	Pressure Flow	2	1					1.08	12.4
MH	1115.0	3220	3640	1101.08	1101.86	420.00	0.0019	39	39	22	2.71	0.00063	0.26	0.1	0.02	1112.66	1112.92	2.3	Pressure Flow		2					1.08	11.9
47th Ave. S.D.																											
MH	1115.0	3640	4060	1101.86	1102.70	420.00	0.0020	39	40	11	1.27	0.00014	0.06	0.1	0.01	1112.93	1112.99	2.1	Pressure Flow	1	1					0.4	3.4
MH	1115.0	4060	4269.	1102.70	1103.12	209.03	0.0020	39	40	7	0.86	0.00006	0.01	0.1	0.00	1112.99	1113.01	2.0	Pressure Flow	2						0.4	2.4
MH	1114.6	4269.	4660	1103.12	1103.98	390.97	0.0022	39	42	5	0.58	0.00003	0.01	0.1	0.00	1113.01	1113.02	1.6	Pressure Flow		1					0.25	1.4
MH	1113.8	4660	4960	1103.98	1104.50	300.00	0.0017	33	24	3	0.57	0.00004	0.01	0.1	0.00	1113.02	1113.03	0.8	Pressure Flow							0.25	0.0
MH	1113.2	4960	5280	1104.50	1105.14	320.00	0.0020	27	15	3	0.86	0.00010	0.03	0.1	0.00	1113.03	1113.06	0.2	Pressure Flow	2	1					0.2	2.3
MH	1113.2	5280	5600	1105.14	1105.78	320.00	0.0020	27	15	1	0.28	0.00001	0.00	0.1	0.00	1113.06	1113.07	0.1	Pressure Flow		1					0.2	1.1
MH	1114.0	5600		1105.78				27		0	0.00	0.00000	0.00	0.1	0.00	1113.07	1113.07	0.9									
Campbell Ave. S.D.																											
MH	1121.0	0	2500	1106.78	1111.00	2500.00	0.0017	36	30	40	5.66	0.00307	7.66	0.1	0.00	1120.22	1127.88	0.8	Pressure Flow								

Notes:
Sf = Pipe Friction Slope based on Manning's Eqn. Sf= (Q*n/1.486*A*R^4/3)^2
hf = Head Loss due to friction slope, hf = Sf*L
km = Sum of minor loss coefficients to be used in minor loss Eqn.
hm = Minor head losses, hm = km*(v^2/2g)

MARYVALE FLOODING MITIGATION PROJECT
STORM SEWER CAPACITY CALCULATION RECORD

Input Variables

Outlet TW elev. =	1057.65
Manning's n =	0.012

51ST AVENUE STORM DRAIN SYSTEM
PROPOSED CONDITIONS

Outlet ID	Existing Grade	From Sta Outlet	To Sta Inlet	Storm Sewer Design Data: Outlet Inv.	Inlet Inv.	Length (ft)	So (ft/ft)	D (in.)	Q full (cfs)	Qpipe (cfs)	Head Loss Calculations: Vpipe (ft/s)	Sf (ft/ft)	hf (ft)	km	hm (ft)	Hyd. Grade Line: Elev. @ outlet	Elev. @ inlet	Depth Below Grade	Comments	Number of Catch Basins: 3'	5-6"	7'	8'	9'	13'	Inflow Rate(cfs/ft)	Inflow (cfs)
51ST AVENUE TRUNK LINE																											
I-10 Interceptor Channel																											
			716		1050.65			84		485	12.60						1057.65		Pressure Flow								
I-10 Outlet	1072.0	716	1382	1050.65	1051.79	666.00	0.0017	84	286	485	12.60	0.00491	3.27	0.3	0.74	1058.39	1061.66	13.6	Pressure Flow		1					1.08	5.9
McDowell Road																										1.08	0.0
Transition Structure	1073.0	1382	2078	1051.79	1054.78	696.00	0.0043	78	372	418	12.58	0.00540	3.76	0.1	0.25	1061.91	1065.67	11.1	Pressure Flow				1			1.08	8.6
MH	1074.5	2078	2740	1054.78	1057.68	662.00	0.0044	78	376	409	12.32	0.00518	3.43	0.1	0.25	1065.92	1069.35	8.6	Pressure Flow			2				1.08	15.1
MH	1077.0	2740	2860	1057.68	1058.10	120.00	0.0035	78	336	394	11.87	0.00481	0.58		0.00	1069.35	1069.93	7.7	Pressure Flow	1	1					1.08	9.2
Grade Break	1077.5	2860	3404	1058.10	1060.37	544.00	0.0042	78	367	385	11.59	0.00459	2.49	0.1	0.22	1070.14	1072.64	7.4	Pressure Flow			1				1.08	7.6
MH	1079.0	3404	4060	1060.37	1063.04	656.00	0.0041	78	362	377	11.36	0.00441	2.89	0.1	0.21	1072.85	1075.74	6.2	Pressure Flow							1.08	0.0
MH	1081.0	4060	4723	1063.04	1065.68	663.00	0.0040	78	358	377	11.36	0.00441	2.92	0.1	0.20	1075.94	1078.86	5.1	Pressure Flow	1	1					1.08	9.2
MH	1083.0	4723	5384	1065.68	1068.37	661.00	0.0041	78	362	368	11.09	0.00420	2.77	0.1	0.20	1079.06	1081.83	3.9	Pressure Flow		1	1				1.08	13.5
MH	1086.0	5384	5542	1068.37	1068.91	158.00	0.0034	78	332	354	10.68	0.00389	0.62		0.00	1081.83	1082.45	4.2	Pressure Flow			3				1.08	22.7
Grade Break	1086.5	5542	6044	1068.91	1071.22	502.00	0.0046	78	385	332	10.00	0.00341	1.71	0.1	0.18	1082.63	1084.34	3.9	Pressure Flow							1.08	0.0
MH	1088.5	6044	6701	1071.22	1074.07	657.00	0.0043	78	374	332	10.00	0.00341	2.24	0.3	0.47	1084.80	1087.05	3.7	Pressure Flow		1					1.08	5.9
Thomas Road																		0.0									
MH	1091.5	6701	6977	1074.07	1075.14	276.00	0.0039	72	286	234	8.27	0.00260	0.72	0.1	0.16	1087.20	1087.92	4.3	Pressure Flow		1		2			1.08	23.2
MH	1092.5	6977	7483	1075.14	1077.20	506.00	0.0041	72	293	211	7.45	0.00211	1.07	0.1	0.11	1088.02	1089.09	4.5	Pressure Flow			1	1			1.08	16.2
MH	1094.0	7483	8145	1077.20	1079.91	662.00	0.0041	72	294	195	6.88	0.00180	1.19	0.1	0.09	1089.18	1090.37	4.8	Pressure Flow							1.08	0.0
MH	1096.5	8145	8746	1079.91	1081.99	601.00	0.0035	72	270	195	6.88	0.00180	1.08	0.1	0.07	1090.44	1091.52	6.1	Pressure Flow							1.08	0.0
MH	1098.5	8746	9405	1081.99	1083.87	659.00	0.0029	72	245	195	6.88	0.00180	1.18		0.00	1091.52	1092.71	7.0	Pressure Flow		1					1.08	5.9
Grade Break	1102.5	9405	9655	1083.87	1085.83	250.00	0.0078	72	406	189	6.67	0.00169	0.42	0.3	0.22	1092.93	1093.35	9.6	Pressure Flow		1	1				1.08	13.5
Crittenden Road																		0.0									
Transition Structure	1105.0	9655	10040	1085.83	1088.59	385.00	0.0072	72	389	20	0.71	0.00002	0.01	0.1	0.07	1093.42	1093.43	11.6	Unsealed @ Sta							1.08	0.0
MH	1105.5	10040	12019	1088.59	1096.21	1979.00	0.0039	72	285	20	0.71	0.00002	0.04	0.3	0.00	1093.43	1093.47	12.1	Unsealed @ Sta							1.08	0.0

MARYVALE FLOODING MITIGATION PROJECT
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Outlet ID	Existing Grade	From Sta Outlet	To Sta Inlet	Storm Sewer Design Data: Outlet inv.	Inlet inv.	Length (ft)	So (ft/ft)	D (in.)	Q full (cfs)	Qpipe (cfs)	Head Loss Calculations: Vpipe (ft/s)	Sf (ft/ft)	hf (ft)	km	hm (ft)	Hyd. Grade Line: Elev. @ outlet	Elev. @ inlet	Depth Below Grade	Comments	Number of Catch Basins: 3'	5-6'	7'	8'	9'	13'	Inflow Rate(cfs/ft)	Inflow (cfs)
LATERAL STORM DRAIN LINES																											
McDowell Road S.D.																											
			986		1053.32			36		61	8.69						1061.91		Pressure Flow							1.08	0.0
51st Ave. S.D.	1073.0	986	1075	1053.32	1055.90	89.00	0.0290	36	123	61	8.69	0.00722	0.64	0.1	0.12	1062.03	1062.67	11.0	Pressure Flow		2					1.08	11.9
MH	1073.0	1075	1500	1055.90	1056.92	425.00	0.0024	36	35	50	7.00	0.00470	2.00	0.1	0.12	1062.79	1064.78	10.2	Pressure Flow							1.08	0.0
MH	1073.0	1500	2380	1056.92	1059.03	880.00	0.0024	36	35	50	7.00	0.00470	4.13	0.1	0.08	1064.86	1068.99	8.1	Pressure Flow	1		1				1.08	10.8
MH	1074.5	2380	2820	1059.03	1060.09	440.00	0.0024	36	35	39	5.48	0.00287	1.26	0.1	0.08	1069.07	1070.33	5.4	Pressure Flow	2						1.08	6.5
MH	1075.5	2820	3253	1060.09	1061.13	433.00	0.0024	36	35	32	4.56	0.00199	0.86	0.1	0.05	1070.38	1071.24	5.1	Pressure Flow	1						1.08	3.2
MH	1074.5	3253	3335	1061.75	1062.88	82.00	0.0138	21	20	29	12.06	0.02856	2.34	0.1	0.03	1071.27	1073.62	3.2	Pressure Flow						2	1	26.0
MH 47th Ave.	1074.5	3335	3826	1062.88	1064.04	491.00	0.0024	21	8	3	1.25	0.00031	0.15	0.1	0.23	1073.84	1073.99	0.7	Pressure Flow		2				1	0.1	2.4
MH	1074.5	3826	4110	1064.04	1065.18	284.00	0.0040	21	11	1	0.25	0.00001	0.00	0.1	0.00	1073.99	1074.00	0.5	Pressure Flow							0.1	0.0
MH	1074.5	4110	4387	1065.18	1066.29	277.00	0.0040	21	11	1	0.25	0.00001	0.00	0.1	0.00	1074.00	1074.00	0.5	Pressure Flow							0.1	0.0
MH	1074.5	4387	4664	1066.29	1067.04	277.00	0.0027	21	9	1	0.25	0.00001	0.00	0.1	0.00	1074.00	1074.00	0.5	Pressure Flow	2						0.1	0.6
MH	1075.0	4664	4940	1067.04	1068.50	276.00	0.0053	21	12	0	0.00	0.00000	0.00	0.1	0.00	1074.00	1074.00	1.0	Pressure Flow		1				1	0	0.0
Thomas Road S.D.																											
			1010		1075.13			54		92	5.78						1087.20		Pressure Flow								
51st Ave. S.D.	1091.5	1010	1360.	1075.13	1075.92	350.70	0.0023	54	101	92	5.78	0.00186	0.65	0.1	0.05	1087.25	1087.90	4.2	Pressure Flow		2					1.08	11.9
MH	1091.8	1360.	1600	1075.92	1076.16	239.30	0.0010	54	67	80	5.03	0.00141	0.34	0.1	0.05	1087.96	1088.29	3.8	Pressure Flow							1.08	0.0
MH	1091.2	1600	1955.	1076.16	1076.51	355.40	0.0010	54	67	80	5.03	0.00141	0.50	0.1	0.04	1088.33	1088.83	2.9	Pressure Flow		1					1.08	5.9
MH	1092.0	1955.	2300	1077.01	1077.41	344.60	0.0012	48	53	74	5.89	0.00226	0.78	0.1	0.04	1088.87	1089.65	3.1	Pressure Flow		2					1.08	11.9
MH	1091.8	2300	2959.	1077.41	1078.81	659.85	0.0021	48	72	62	4.95	0.00160	1.05	0.1	0.05	1089.71	1090.76	2.1	Pressure Flow		1	2				1.08	21.1
MH	1092.3	2959.	3042.	1079.31	1079.44	82.40	0.0016	42	43	41	4.27	0.00142	0.12	0.1	0.04	1090.80	1090.91	1.5	Pressure Flow			2				1.08	15.1
MH	1093.3	3042.	3400	1079.94	1080.51	357.75	0.0016	36	29	26	3.67	0.00129	0.46	0.1	0.03	1090.94	1091.41	2.4	Pressure Flow		1					1.08	5.9
MH	1093.3	3400	3737	1080.51	1081.45	337.00	0.0028	36	38	20	2.83	0.00077	0.26	0.1	0.02	1091.43	1091.69	1.9	Pressure Flow				1			1.08	8.6
MH	1093.8	3737	3843	1081.45	1081.62	106.00	0.0016	36	29	11	1.61	0.00025	0.03	0.1	0.01	1091.70	1091.72	2.1	Pressure Flow		2		1			0.6	11.4
MH	1093.7	3843	4328	1081.87	1082.89	485.00	0.0021	33	26	0	0.00	0.00000	0.00	0.1	0.00	1091.73	1091.73	2.0	Pressure Flow		2					0	0.0
MH	1092.8	4328	4518	1083.64	1084.06	190.00	0.0022	24	12	0	0.00	0.00000	0.00	0.1	0.00	1091.73	1091.73	1.1	Pressure Flow		3	2				0	0.0
MH	1092.1	4518	4800	1084.31	1084.93	282.00	0.0022	21	8	0	0.00	0.00000	0.00	0.1	0.00	1091.73	1091.73	0.4	Pressure Flow							0	0.0
MH	1092.8	4800	5050	1083.64	1085.73	250.00	0.0084	21	16	0	0.00	0.00000	0.00	0.1	0.00	1091.73	1091.73	1.1	Pressure Flow				1			0	0.0
MH	1093.3	5050	5133	1085.73	1085.94	83.00	0.0025	18	6	0	0.00	0.00000	0.00	0.1	0.00	1091.73	1091.73	1.6	Pressure Flow				1			0	0.0
MH	1093.3	5133	5500	1085.94	1086.75	367.00	0.0022	18	5	0	0.00	0.00000	0.00	0.1	0.00	1091.73	1091.73	1.6	Pressure Flow		2					0	0.0
Crittenden S.D.																											
			0		1086.45			54		155	9.75						1093.42		Pressure Flow								
51st Ave. S.D.	1105.0	0	416	1086.45	1088.50	416.00	0.0049	54	150	155	9.75	0.00530	2.20	0.1	0.15	1093.57	1095.77	11.4	Pressure Flow	2						2.20	13.2
Transition Structure	1104.0	416	1077	1088.50	1090.08	661.00	0.0024	54	104	142	8.92	0.00444	2.93	0.1	0.15	1095.92	1098.85	8.1	Pressure Flow							2.20	0.0
MH	1104.0	1077	1930	1090.08	1092.15	853.00	0.0024	54	105	142	8.92	0.00444	3.78	0.1	0.12	1098.97	1102.76	5.0	Pressure Flow	3		2	1			2.20	68.2
MH	1103.5	1930	2276	1092.15	1093.13	346.00	0.0028	54	113	74	4.63	0.00120	0.41	0.1	0.12	1102.88	1103.30	0.6	Pressure Flow							2.20	0.0
MH	1103.0	2276	2827	1092.39	1094.15	551.00	0.0032	48	88	74	5.86	0.00224	1.24	0.1	0.03	1103.33	1104.56	-0.3	Pressure Flow		1	2				2.20	42.9
MH	1104.0	2827	3841	1094.15	1096.03	1014.00	0.0019	48	67	31	2.45	0.00039	0.40	0.1	0.05	1104.62	1105.02	-0.6	Pressure Flow							2.20	0.0
MH	1104.9	3841	4097	1094.40	1096.44	256.00	0.0080	42	97	31	3.20	0.00080	0.20	0.1	0.01	1105.02	1105.23	-0.1	Pressure Flow			2				2.20	30.8

Notes:
Sf = Pipe Friction Slope based on Manning's Eqn. Sf= (Q*n/1.486*A*R^4/3)^2
hf = Head Loss due to friction slope, hf = Sf*L
km = Sum of minor loss coefficients to be used in minor loss Eqn.
hm = Minor head losses, hm = km*(v^2/2g)

APPENDIX III
ALTERNATIVES

DO NOTHING ALTERNATIVE

DO NOTHING ALTERNATIVE

Leaving the problem areas as they currently exist may not be politically or socially acceptable, but should be considered. This alternative may be chosen because of the excessive costs, and/or because of the inadequate benefits of the other alternatives. Another reason to default to this alternative is the reallocation of construction funds to other projects.

Pros	Cons
• No cost.	• Homes and neighborhoods are repeatedly impacted during storms.
• Maintains the status quo.	• Continued maintenance cost due to repeated flooding.
	• Property values may depreciate.
	• Economic losses to homeowners because of their inability to sell their houses.
	• Possibility of damage claims.

ALTERNATIVES AI AND B1

ALTERNATIVES A-1 AND B-1

Buy all existing properties which are subject to flooding and have had repetitive losses. FEMA has a fund which might help finance this option.

Pros	Cons
• May require buy-out of fewer homes then the structural flood control alternatives.	• Disruptive to neighborhood with no floodproof benefit to remaining homes. • Difficult to determine which homes are to remain and which will be removed. • Vacant property needs to be maintained by the City. • Hardship to residents who have to move.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE A1

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1		Structure Demolition	65	EA	5,000	$325,000
		Landscape Restoration	15	AC	40,000	$600,000

Subtotal	$925,000
Engineering & Contingencies @ 40%	$370,000
Land Acquisition	$5,760,000
Surveying & Other Acquisition Costs @ 20%	$1,152,000
TOTAL PROJECT BUDGET	**$8,207,000**

Note:

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MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B1

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1		House Demolition	77	EA	5,000	$385,000
		Landscape Restoration	12	AC	40,000	$480,000

Subtotal	$865,000
Engineering & Contingencies @ 40%	$346,000
Land Acquisition	$4,188,000
Surveying & Other Acquisition Costs @ 20%	$837,600
TOTAL PROJECT BUDGET	**$6,236,600**

Note:

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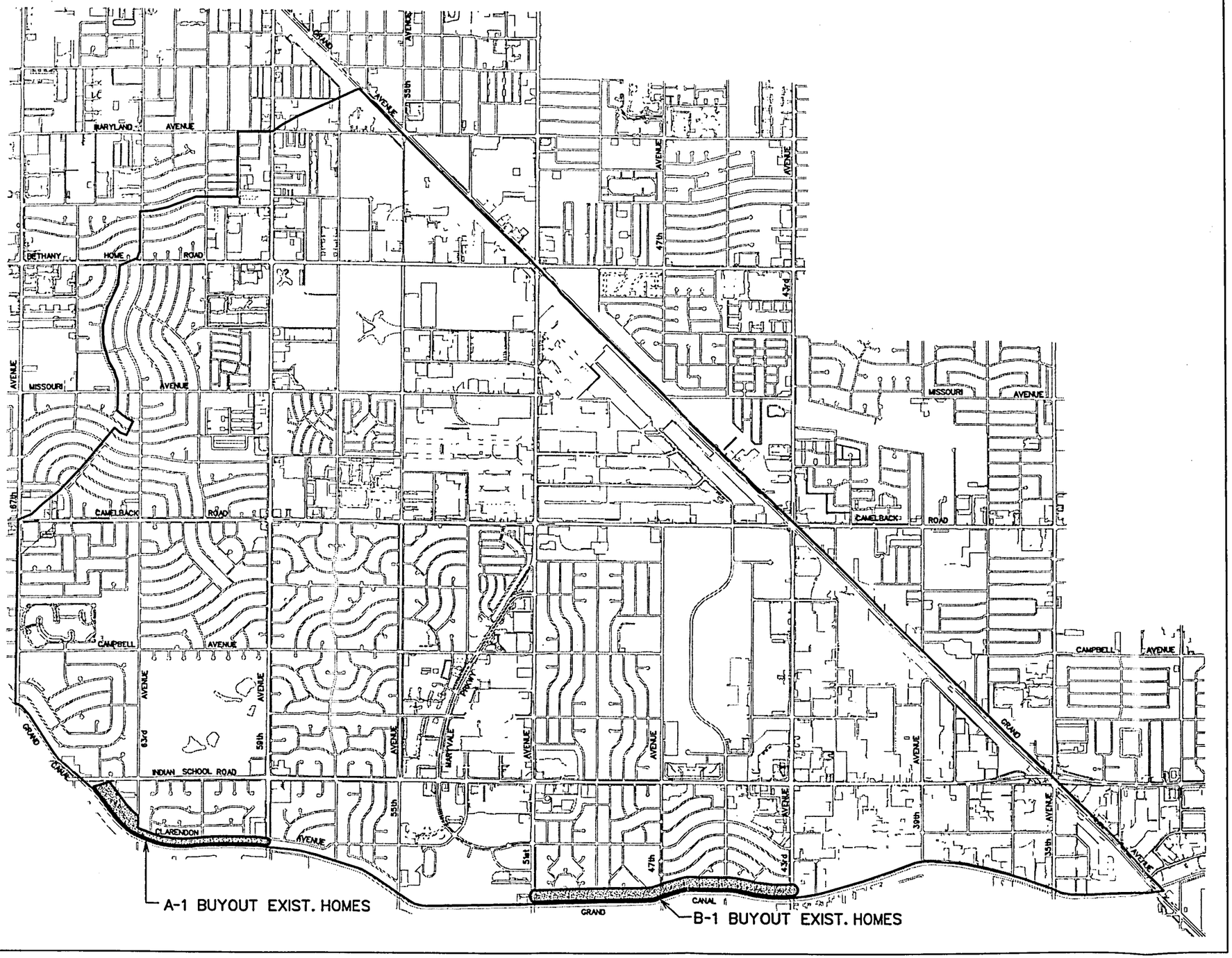
Coe & Van Loo Consultants, Inc.



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF
MARYVALE
FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

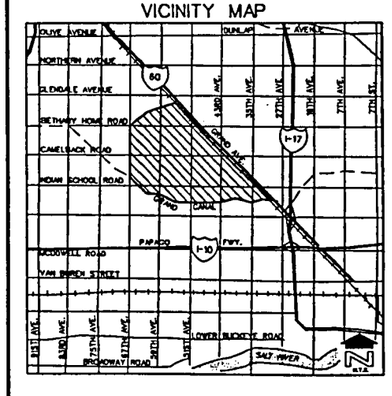
CONCEPTUAL FLOOD CONTROL ALTERNATIVES

ALTERNATIVE A-1 & B-1

LEGEND

- Channel / Storm Drain
- Detention Basin
- Potential Area of Buyout

VICINITY MAP



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SCALE IN FEET
CONTOUR INTERVAL - 10' FEET

COE & VAN LOO, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

PLATE A-1/B-1

JOB NO. 950024

DATE:- JUL 19, 1995
TIME:- 10:30:39
FILE:- e:\950024\hydro\altmap.dgn

LV-1

ALTERNATIVES A-2 AND B-2

ALTERNATIVES A-2 AND B-2

Floodproof existing homes that are subject to flooding. Floodproofing might include some sort of permanent storm wall. Sandbags are not an option because of the need for human intervention. A cost estimate is not provided because of the difficulty of determining costs since floodproofing solutions - and their magnitudes - may vary greatly.

Pros	Cons
• Least-cost alternative	• Inconveniences homeowners on a regular basis.
• Does not require any residents to move.	• May not be possible in some of the deepest ponding areas.
	• Difficulty in deriving a passive floodproofing solution.
	• May be able to floodproof houses, but sections of residential streets may still be flooded.
	• Minimal maintenance cost for occasional street closure and cleanup.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE A2

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1		Floodproof Exisitng Houses	?	EA	?	

Subtotal	$0
Engineering & Contingencies @ 40%	$0
Land Acquisition	
Surveying & Other Acquisition Costs @ 20%	
TOTAL PROJECT BUDGET	**$0**

Note:

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MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B2

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1		Floodproof Exisitng Houes	?	EA	?	

Subtotal	$0
Engineering & Contingencies @ 40%	$0
Land Acquisition	
Surveying & Other Acquisition Costs @ 20%	
TOTAL PROJECT BUDGET	**$0**

Note:

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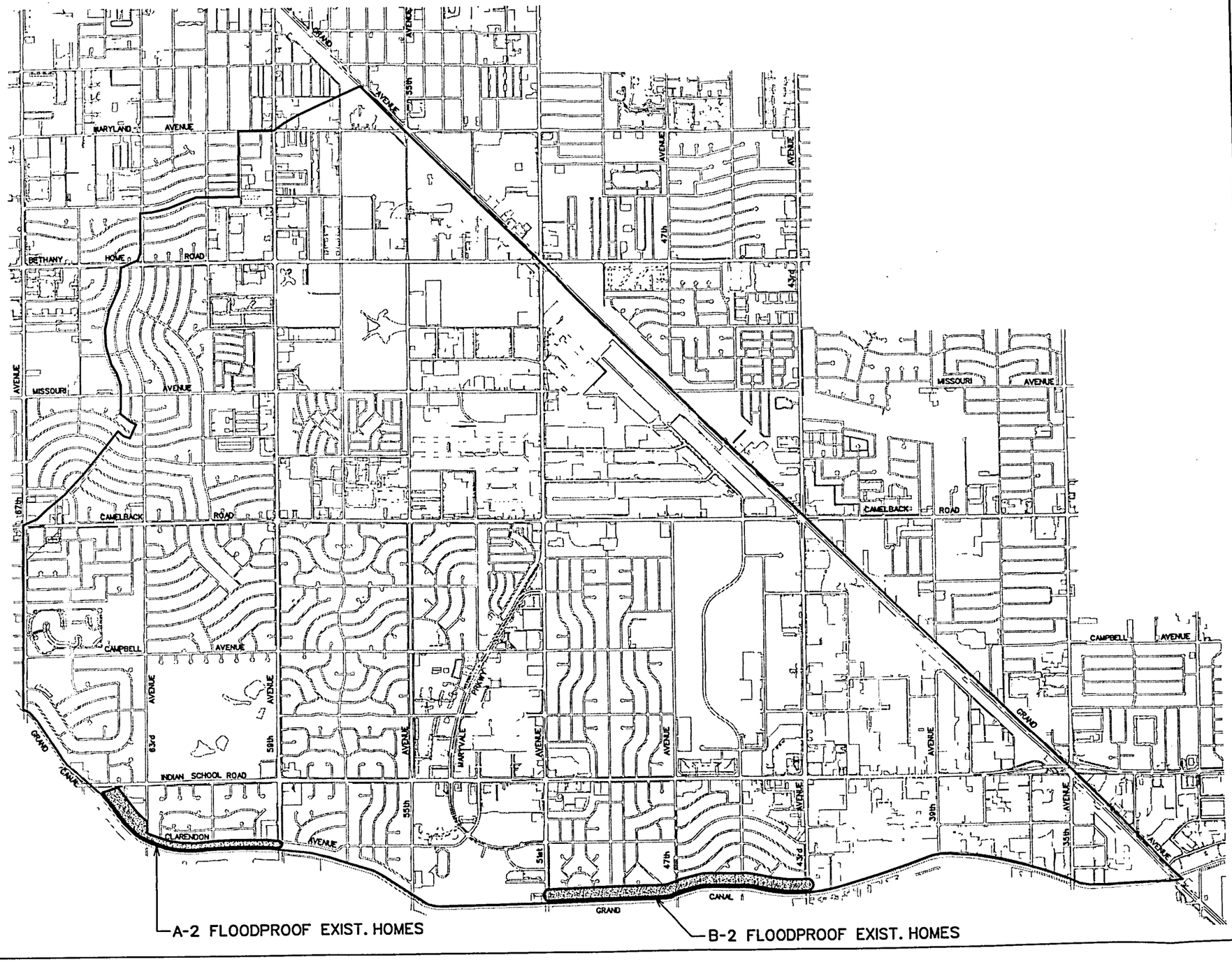
Coe & Van Loo Consultants, Inc.



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF

MARYVALE FLOODING MITIGATION PROJECT

F.C.D. CONTRACT NO. 93-94

CONCEPTUAL FLOOD CONTROL ALTERNATIVES

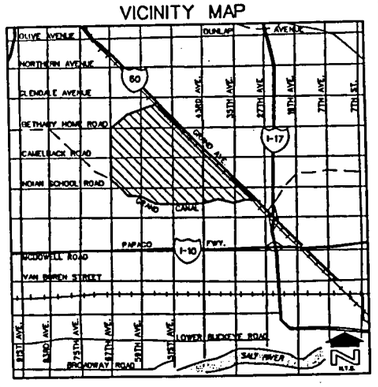
ALTERNATIVE A-2 & B-2

LEGEND

Channel / Storm Drain

Detention Basin

VICINITY MAP



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SCALE IN FEET

CONTOUR INTERVAL - 10' FEET

COE & VAN LOO, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

PLATE A-2/B-2

JOB NO. 950024

DATE:- Jul 19, 1995
TIME:- 13:36:18
FILE:- e:\950024\vrydra\alt.dgn

LV-22

ALTERNATIVE A-3

ALTERNATIVE A-3

Enlarge Indian School bridge over the Grand Canal to improve capacity. No cost estimate is provided because qualitative analysis shows that the cost of enlarging the bridge for an urban arterial is very high.

Pros	Cons
• None	• Very expensive. • Does not alleviate the problem. • Provides less than 100-year protection.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE A3

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1		Improve Cap. of Indian School Rd Bridge	?	LS	?	

Subtotal	$0
Engineering & Contingencies @ 40%	$0
Land Acquisition	
Surveying & Other Acquisition Costs @ 20%	
TOTAL PROJECT BUDGET	**$0**

Note:

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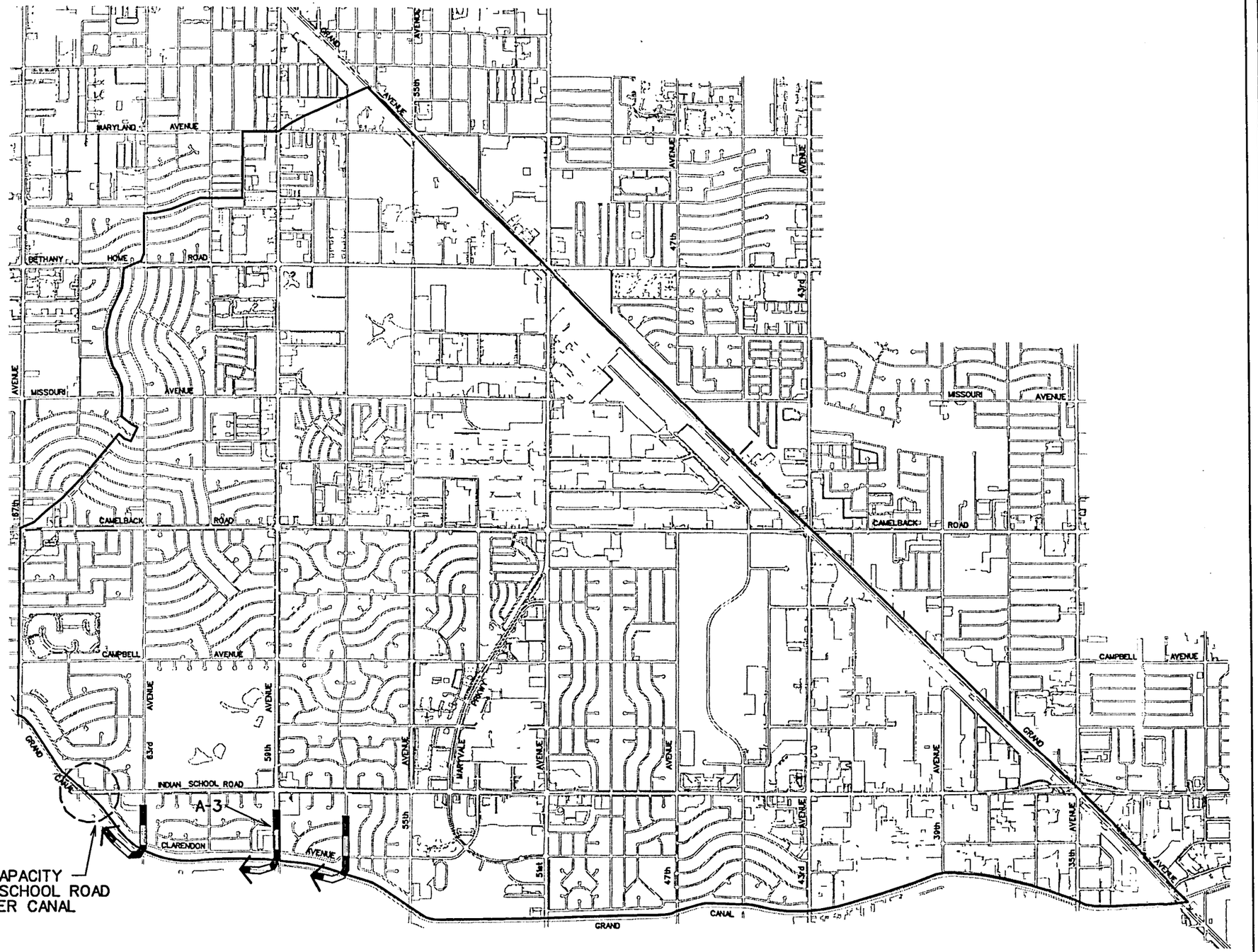
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF
MARYVALE
FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

CONCEPTUAL FLOOD CONTROL ALTERNATIVES

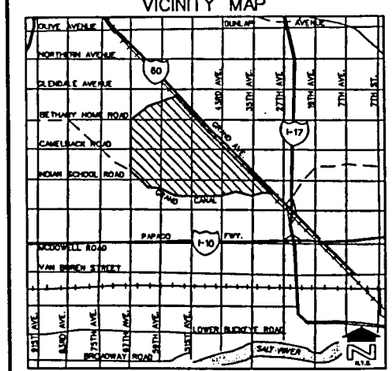
ALTERNATIVE A-3



LEGEND

Channel / Storm Drain

VICINITY MAP



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SCALE IN FEET
CONTOUR INTERVAL = 10' FEET

COE & VAN LOO, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

PLATE A-3

JOB NO. 950024

DATE: Jul 18, 1995
TIME: 08:38:18
FILE: a:\950024\hydro\altmap.dgn
LV-3

ALTERNATIVES A-4-1 AND A-4-2

ALTERNATIVES A-4-1 AND A-4-2

Construct a detention basin within the Maryvale Municipal Golf Course to intercept the floodwaters that reach area A. Storage volume is estimated at 165 acre-feet for Alternative A-4-1 and 229 acre-feet for Alternative A-4-2. Alternative A-4-1 allows low flows to bypass the basin and drains the basin to the 67th Avenue storm drain. Alternative A-4-2 diverts all flows into the basin and drains the basin to the 59th Avenue storm drain. Storm drain collection systems along Camelback Road, Indian School Road, and 59th Avenue are included in both alternatives.

Pros

- Using City-owned golf course for location of detention basin results in no land acquisition costs.
- Public inconveniences are limited to the period of construction and the period of golf course restoration.
- Enhances usefulness of existing storm drains.
- Provides 100-year level of protection.
- Does not require any residents to move.
- Low flow diversions past the basin minimizes the effect on golfers. (A-4-1 only)

Cons

- City Parks Department may not allow use of golf course for detention.
- Part of golf course is out of service during construction and restoration.
- Cost of golf course restoration is high.
- Possibility that golf course cannot be restored for use by golfers.
- Intercepts runoff only from the drainage basin north of Area A. (A-4-1 only)
- Routing of all drainage through the golf course increases the likelihood that there is always water on the course (A-4-2 only)
- Slightly more maintenance cost than the existing golf course.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE A4-1

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1	165 AF	Detention Basin Excavation	266,000	CY	$3.00	$798,000
		24" RGRCP	5,280	LF	$60.00	$316,800
		42" RGRCP	1,400	LF	$105.00	$147,000
		54" RGRCP	1,400	LF	$125.00	$175,000
		66" RGRCP	1,000	LF	$140.00	$140,000
		72" RGRCP	3,300	LF	$160.00	$528,000
		108" RGRCP	8,000	LF	$295.00	$2,360,000
		114" RGRCP	1,200	LF	$305.00	$366,000
		126" RGRCP	1,700	LF	$325.00	$552,500
		144" RGRCP	3,000	LF	$365.00	$1,095,000
	40 AC	Golf Course Restoration	40	AC	$80,000.00	$3,200,000

Subtotal	$9,678,300
Engineering & Contingencies @ 40%	$3,871,320
Land Acquisition	$0
Surveying & Other Acquisition Costs @ 20%	$0
TOTAL PROJECT BUDGET	$13,549,620

Note:

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MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE A4-2

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1	229 AF	Detention Basin Excavation	370,000	CY	$3.00	$1,110,000
		24" RGRCP (bleed off)	500	LF	$60.00	$30,000
		42" RGRCP	1,400	LF	$105.00	$147,000
		54" RGRCP	1,400	LF	$125.00	$175,000
		66" RGRCP	1,000	LF	$140.00	$140,000
		72" RGRCP	3,300	LF	$160.00	$528,000
		108" RGRCP	8,000	LF	$295.00	$2,360,000
		114" RGRCP	1,200	LF	$305.00	$366,000
		126" RGRCP	1,700	LF	$325.00	$552,500
		144" RGRCP	3,000	LF	$365.00	$1,095,000
		Golf Course Restoration	55	AC	$80,000.00	$4,400,000

Subtotal	$10,903,500
Engineering & Contingencies @ 40%	$4,361,400
Land Acquisition	$0
Surveying & Other Acquisition Costs @ 20%	$0
TOTAL PROJECT BUDGET	$15,264,900

Note:

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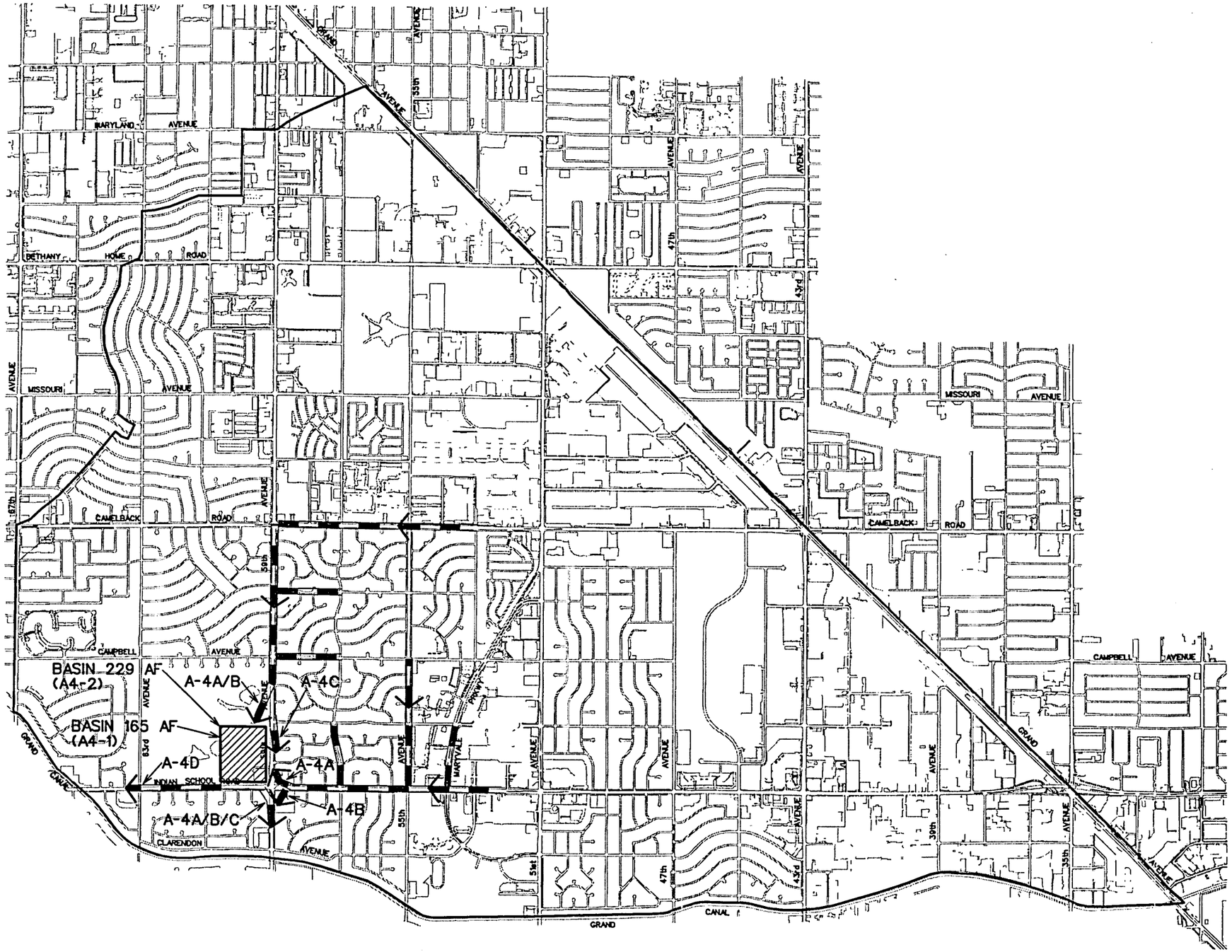
Coe & Van Loo Consultants, Inc.



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF

MARYVALE

FLOODING MITIGATION PROJECT

F.C.D. CONTRACT NO. 93-94

CONCEPTUAL FLOOD CONTROL ALTERNATIVES

ALTERNATIVE A4-1 & A4-2

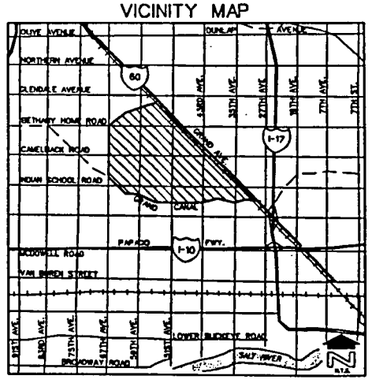
LEGEND

Channel / Storm Drain

OPTION

A	Indian School S.D. into Golf Course
B	Indian School S.D. into 59th Ave. S.D.
C	Low Flows Bypass Detention Basin
D	Bleed-off to 67th Ave. S.D.

VICINITY MAP



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SCALE IN FEET

CONTOUR INTERVAL - 10' FEET

COE & VAN LOO, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

PLATE A4-1/A4-2

JOB NO. 950024

DATE: Jul 19 1993
TIME: 15:38:18
FILE: e:\950024\hydro\alt\map.dgn

LV-2

ALTERNATIVE A-5

ALTERNATIVE A-5

Construct a 274 acre-foot detention basin southwest of Indian School and 63rd Avenue. Construct a storm drain collection system along Indian School Road to intercept runoff from the north and divert it to the basin. Outlet the basin either to the 67th Avenue or 59th Avenue storm drains.

Pros	Cons
• Collects runoff from both basins contributing to Area A.	• May need to install upstream storm drains to collect storm runoff.
• Provides 100-year level of protection.	• Most expensive alternative for Area A.
• Detention area could be utilized as a City park.	• Hardship to those residents who have to move for construction of the detention basin.
• Utilizes existing storm drain facilities for bleed-off.	• High maintenance costs associated with a park.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE A5

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1	274 AF	Detention Basin Excavation	442,000	CY	$3.00	$1,326,000
		24" RGRCP	2,640	LF	$60.00	$158,400
		42" RGRCP	1,400	LF	$105.00	$147,000
		54" RGRCP	1,400	LF	$125.00	$175,000
		108" RGRCP	8,480	LF	$295.00	$2,501,600
		114" RGRCP	1,200	LF	$305.00	$366,000
		120" RGRCP	3,000	LF	$315.00	$945,000
		144" RGRCP	1,300	LF	$365.00	$474,500
		Demolition (35 residences, 1 Church & 1 Fire Station)	1	LS	$221,000.00	$221,000
		Land Restoration	23	AC	$40,000.00	$920,000

Subtotal	$7,234,500
Engineering & Contingencies @ 40%	$2,893,800
Land Acquisition	$7,947,000
Surveying & Other Acquisition Costs @ 20%	$1,589,400
TOTAL PROJECT BUDGET	$19,664,700

Note:

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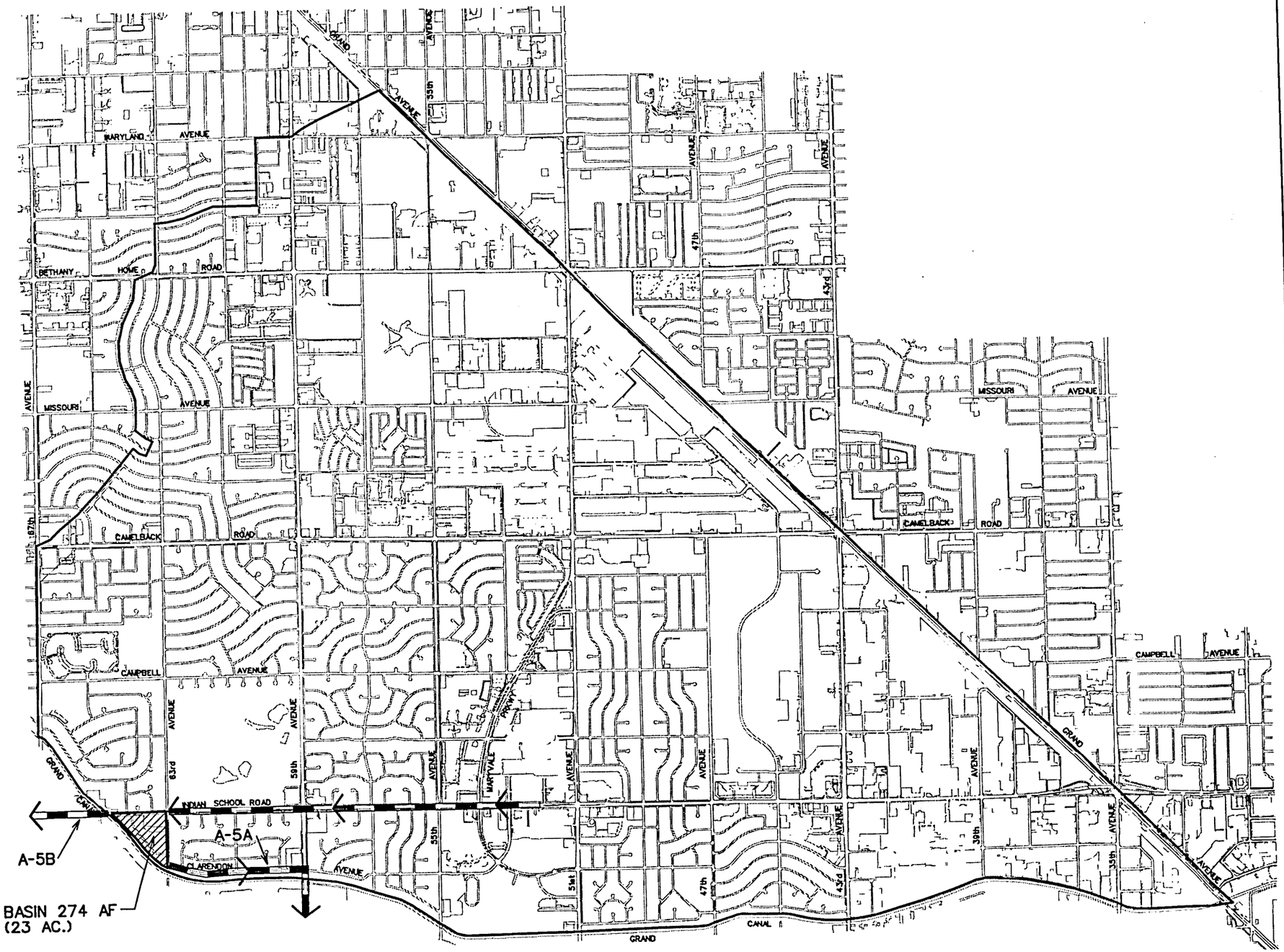
Coe & Van Loo Consultants, Inc.



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF

MARYVALE
FLOODING MITIGATION PROJECT

F.C.D. CONTRACT NO. 93-94

CONCEPTUAL FLOOD CONTROL ALTERNATIVES

ALTERNATIVE A-5

LEGEND

Channel / Storm Drain

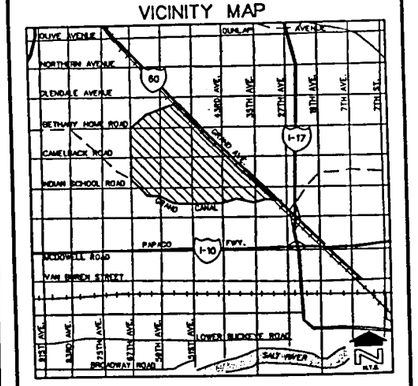
Detention Basin

OPTION

A — Bleed-off to 59th Ave. S.D.

B — Bleed-off to Indian school S.D.

VICINITY MAP



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SCALE IN FEET
CONTOUR INTERVAL - 10' FEET

COE & VAN LOO, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

PLATE A-5

JOB NO. 950024

DATE:- Jul. 19, 1995
TIME:- 15:36:18
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LV=8

ALTERNATIVE B-3

ALTERNATIVE B-3

Construct a detention basin on the upstream end of the Grand Canal around the 39th Avenue alignment. A side weir would divert flood flows into the basin from the Grand Canal, thus leaving the excess capacity in the canal to convey flood flows contributed by downstream neighborhoods.

Pros	Cons
• Minimal construction costs.	• Salt River Project (SRP) may not be amenable to having their canal breached.
• Minimal land acquisition costs.	• SRP-owned canals are not intended for flood control use.
• Probably does not require any residents to move.	• Does not provide 100-year level of protection.
• Low, if any, maintenance costs.	

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B3

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1	165 AF	Detention Basin Excavation	266,000	CY	$3.00	$798,000
	72"	Detention Basin Storm Drain Outlet	500	LF	$175.00	$87,500
		Concrete Spillway	1	EA	20,000	$20,000

Subtotal	$905,500
Engineering & Contingencies @ 40%	$362,200
Land Acquisition	$6,400,000
Surveying & Other Acquisition Costs @ 20%	$1,280,000
TOTAL PROJECT BUDGET	**$8,947,700**

Note:

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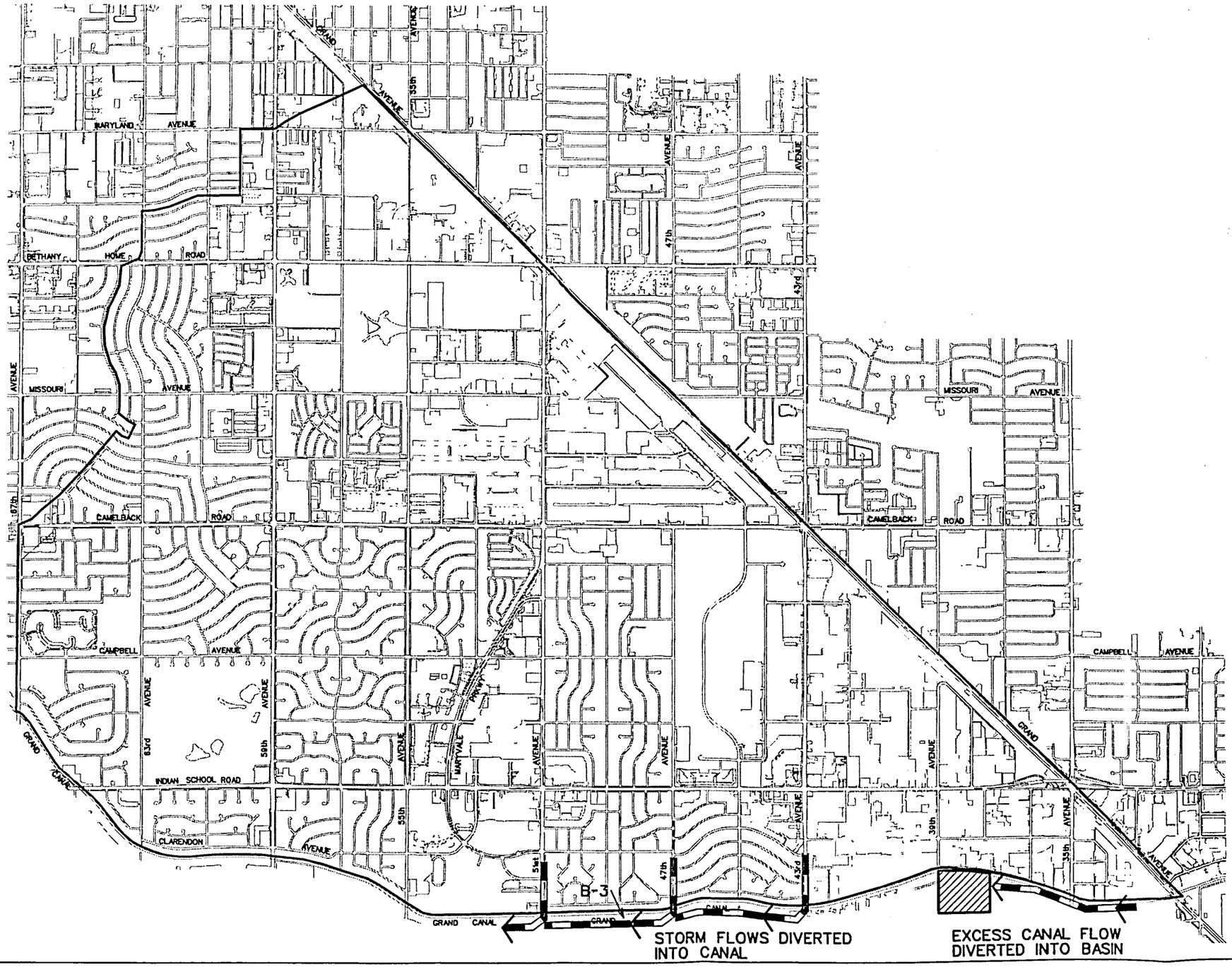
Coe & Van Loo Consultants, Inc.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF
MARYVALE
FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

CONCEPTUAL FLOOD CONTROL ALTERNATIVES

ALTERNATIVE B-3

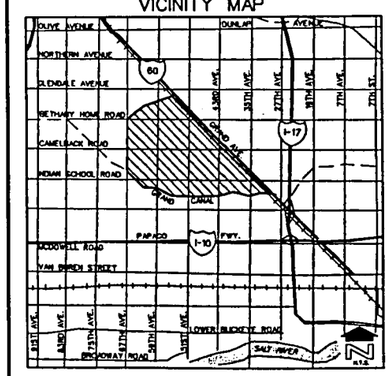


LEGEND

Channel / Storm Drain

Detention Basin

VICINITY MAP



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SCALE IN FEET
CONTOUR INTERVAL - 10' FEET

COE & VAN LOO, INC.

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DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

PLATE B-3

JOB NO. 950024

DATE: JUL 19, 1995
TIME: 12:36:18
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LV-23

ALTERNATIVE B-4

ALTERNATIVE B-4

Construct a channel along the north side of the Grand Canal to intercept runoff. Construct a downstream channel or storm drain south to the I-10 freeway channel.

Pros	Cons
• Provides 100-year level of protection.	• Most expensive alternative for Area B.
• Downstream box culvert could be upgraded to carry runoff from drainage basins south of the canal.	• Hardship to those residents who have to move for construction of the channel along the canal.
	• Moderate channel maintenance costs.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B-4

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
		Channel Excavation	33000	CY	$3.00	$99,000
1	1300 CFS	Concrete Channel B.P. (6" Thick)	5600		$280.00	$1,568,000
		Demolition	77	EA	$5,000	$385,000
		9,240 LF 4-9'x8' CBC	1	LS	$10,458,500	$10,458,500

Subtotal	$12,510,500
Engineering & Contingencies @ 40%	$5,004,200
Land Acquisition	$4,188,000
Surveying & Other Acquisition Costs @ 20%	$837,600
TOTAL PROJECT BUDGET	**$22,540,300**

Note:

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

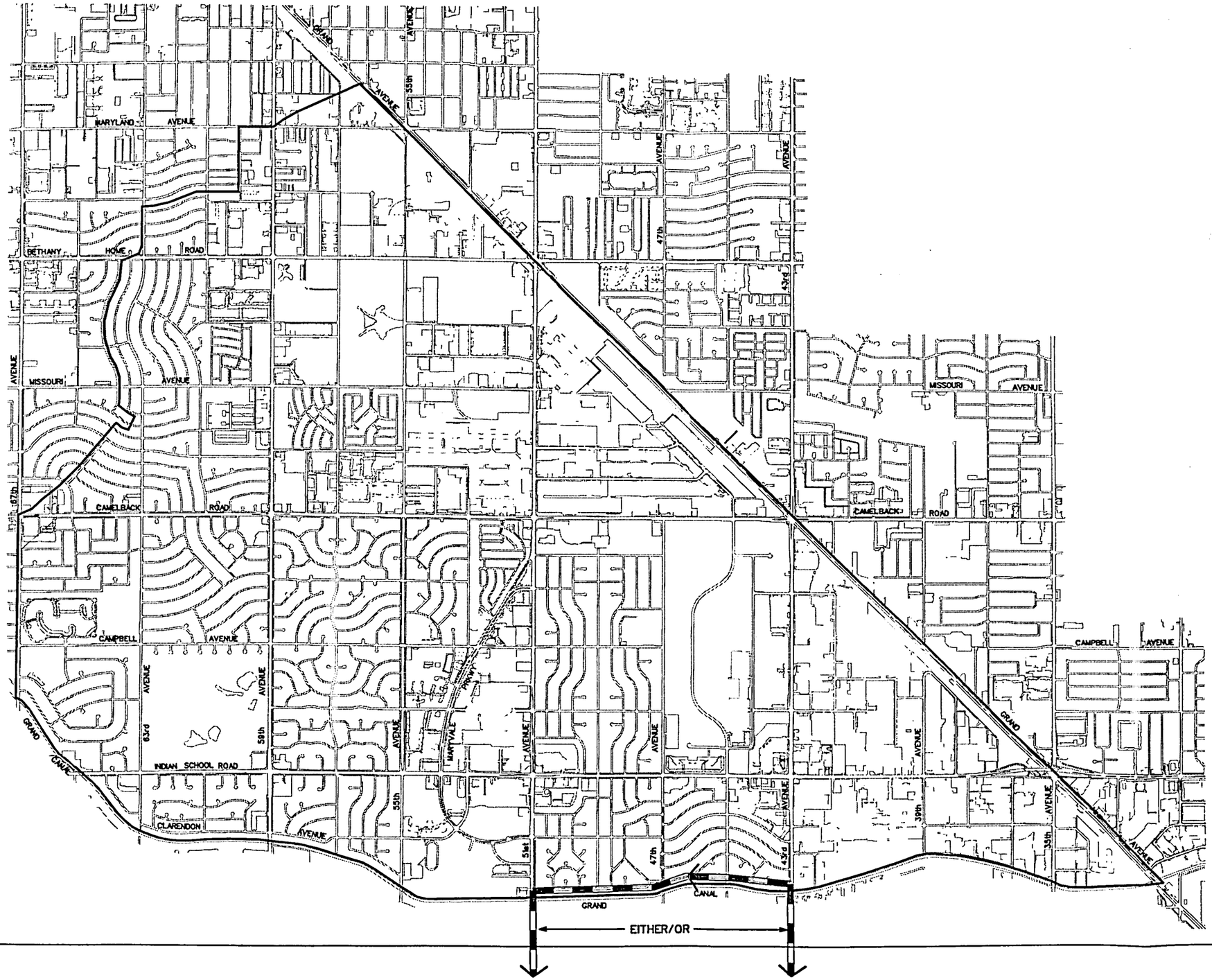
FLOOD DELINEATION STUDY OF

MARYVALE FLOODING MITIGATION PROJECT

F.C.D. CONTRACT NO. 93-94

CONCEPTUAL FLOOD CONTROL ALTERNATIVES

ALTERNATIVE B-4

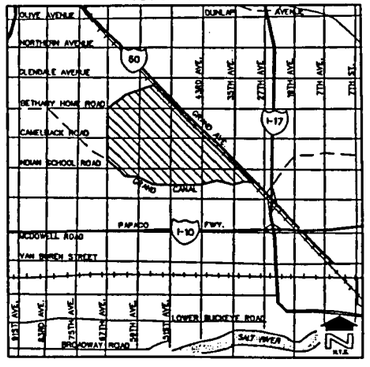


LEGEND

Channel / Storm Drain

Detention Basin

VICINITY MAP



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SCALE IN FEET

CONTOUR INTERVAL = 10' FEET

COE & VAN LOO, INC.

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SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

PLATE B-4

JOB NO. 950024

LV-4

DATE: JUL 19, 1995
TIME: 10:36:18
FILE: g:\950024\hydro\altmap.dgn

ALTERNATIVE B-5

ALTERNATIVE B-5

Construct a drainage channel along the north side of the Grand Canal which outlets into a detention basin within an undeveloped industrial park on the north side of the canal between 51st and 55th Avenues. Alternative B-5 includes a 192 acre-foot detention basin with a 24-inch bleed-off pipe into the 51st Avenue storm drain.

Pros

- Provides 100-year level of protection.
- Detention basin is on undeveloped property.
- Relatively low maintenance cost for an unimproved basin and channel.

Cons

- May require upstream storm drain.
- Hardship to those who have to move for construction of the drainage channel along the canal.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B5

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1	192 AF	Detention Basin Excavation at Grand Canal & 53rd Ave.	310,000	CY	$3.00	$930,000
		Channel Excavation	33,000	CY	$3.00	$99,000
		Concrete Channel Paving (6" thk)	5,600	CY	$280.00	$1,568,000
		24" RGRCP	1,320	LF	$55.00	$72,600
		Demolition	77	EA	$5,000.00	$385,000
		Fencing & Screening	4,900	LF	$26.00	$127,400

Subtotal	$3,182,000
Engineering & Contingencies @ 40%	$1,272,800
Land Acquisition	$7,421,000
Surveying & Other Acquisition Costs @ 20%	$1,484,200
TOTAL PROJECT BUDGET	**$13,360,000**

Note:

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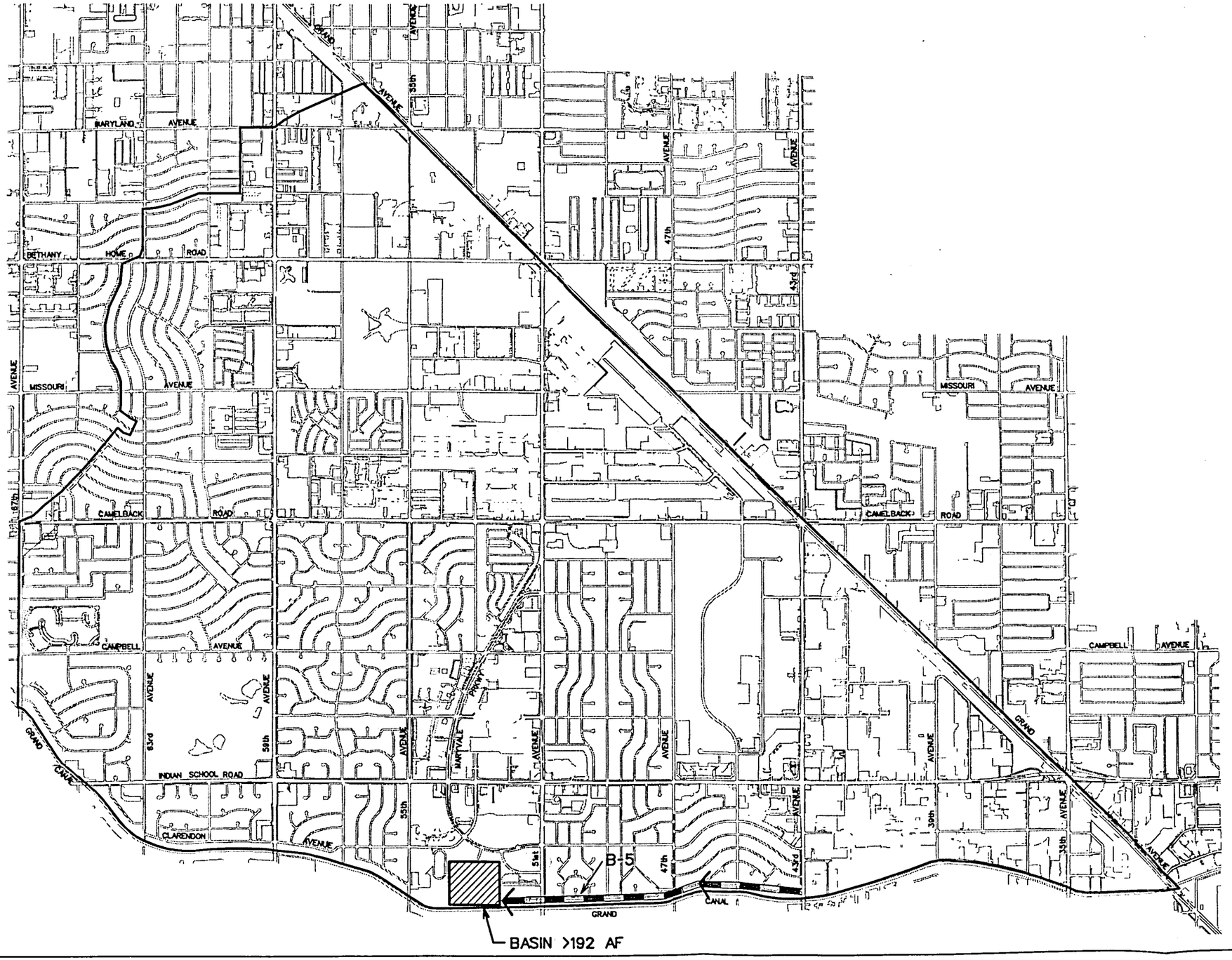
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF
MARYVALE
FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

CONCEPTUAL FLOOD CONTROL ALTERNATIVES

ALTERNATIVE B-5

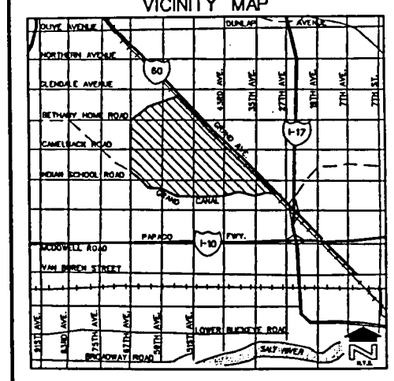


LEGEND

Channel / Storm Drain

Detention Basin

VICINITY MAP



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SCALE IN FEET
CONTOUR INTERVAL - 10' FEET

COE & VAN LOO, INC.

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DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

PLATE B-5

JOB NO. 950024

DATE:- Jul 19, 1995
TIME:- 15:38:18
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LV-25

ALTERNATIVE B-6

ALTERNATIVE B-6

Construct a drainage channel along the north side of the Grand Canal which outlets into a detention basin within an undeveloped industrial park on the north side of the canal between 51st and 55th Avenues. Alternative B-6 includes a 119 acre-foot detention basin with a 72-inch bleed-off pipe into the 51st Avenue storm drain.

Pros	Cons
• Provides 100-year level of protection.	• May require upstream storm drain.
• Detention basin is on undeveloped property.	• Hardship to those who have to move for construction of the drainage channel along the canal.
• Relatively low maintenance cost for an unimproved basin and channel.	

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B6

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1	119 AF	Detention Basin Excavation	192,000	CY	$3.00	$576,000
		at Grand Canal & 53rd Ave.				
		Channel Excavation	33,000	CY	$3.00	$99,000
		Concrete Channel Paving (6" thk)	5,600	CY	$280.00	$1,568,000
		72" RGRCP	1,320	LF	$160.00	$211,200
		Demolition	77	EA	$5,000.00	$385,000
		Fencing & Screening	4,600	LF	$26.00	$119,600
		Subtotal				$2,958,800
		Engineering & Contingencies @ 40%				$1,183,520
		Land Acquisition				$7,421,000
		Surveying & Other Acquisition Costs @ 20%				$1,484,200
		TOTAL PROJECT BUDGET				**$13,047,520**

Note:

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Coe & Van Loo Consultants, Inc.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF

MARYVALE FLOODING MITIGATION PROJECT

F.C.D. CONTRACT NO. 93-94

CONCEPTUAL FLOOD CONTROL ALTERNATIVES

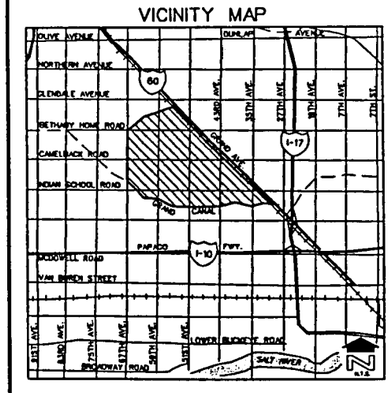
ALTERNATIVE B-6

LEGEND

Channel / Storm Drain

Detention Basin

VICINITY MAP



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SCALE IN FEET

CONTOUR INTERVAL = 10' FEET

COE & VAN LOO, INC.

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DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
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SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

PLATE B-6

JOB NO. 950024

DATE: JUL 19, 1995
TIME: 10:36:00
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LV-5

ALTERNATIVE B-7

ALTERNATIVE B-7

Construct a storm drain collection system westerly along Indian School Road and southerly along 51st Avenue. Low flows remain in the 51st Avenue storm drain while larger flows are diverted into a 157 acre-foot detention basin in the undeveloped industrial park mentioned in Alternatives B-5 and B-6. The basin would drain south to the existing I-10 channel.

Pros

- Off-line detention basin keeps low flows out of basin.
- Extensive storm drain system provides good runoff interception.
- Possible to upgrade downstream pipe to allow use of storm drain to carry runoff from area between the Grand Canal and I-10.
- Provides 100-year level of protection.
- Detention basin is on undeveloped property.

Cons

- May not be room in Indian School Road or 51st Avenue for the size of pipe required due to existing utilities.
- Close second to Alternative B-4 for highest costs.
- Maintenance costs for an unimproved basin.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B7

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
	157 AF	Detention Basin Excavation	253,000	CY	$3.00	$759,000
		30" RGRCP	9,240	LF	$75.00	$693,000
		54" RGRCP	3,000	LF	$125.00	$375,000
		66" RGRCP	500	LF	$140.00	$70,000
		72" RGRCP	800	LF	$160.00	$128,000
		78" RGRCP	3,000	LF	$215.00	$645,000
		84" RGRCP	500	LF	$255.00	$127,500
		90" RGRCP	800	LF	$285.00	$228,000
		11' RGRCP	2,000	LF	$345.00	$690,000
		12' RGRCP	3,000	LF	$365.00	$1,095,000
		3-10'x8' CBC	2,500	LF	$985.60	$2,464,000
		4-9'x8' CBC	3,500	LF	$1,131.60	$3,960,600
		Fencing & Screening	4,400	LF	$26.00	$114,400
		Subtotal				$11,349,500
		Engineering & Contingencies @ 40%				$4,539,800
		Land Acquisition				$3,232,500
		Surveying & Other Acquisition Costs @ 20%				$646,500
		TOTAL PROJECT BUDGET				**$19,768,300**

Note:

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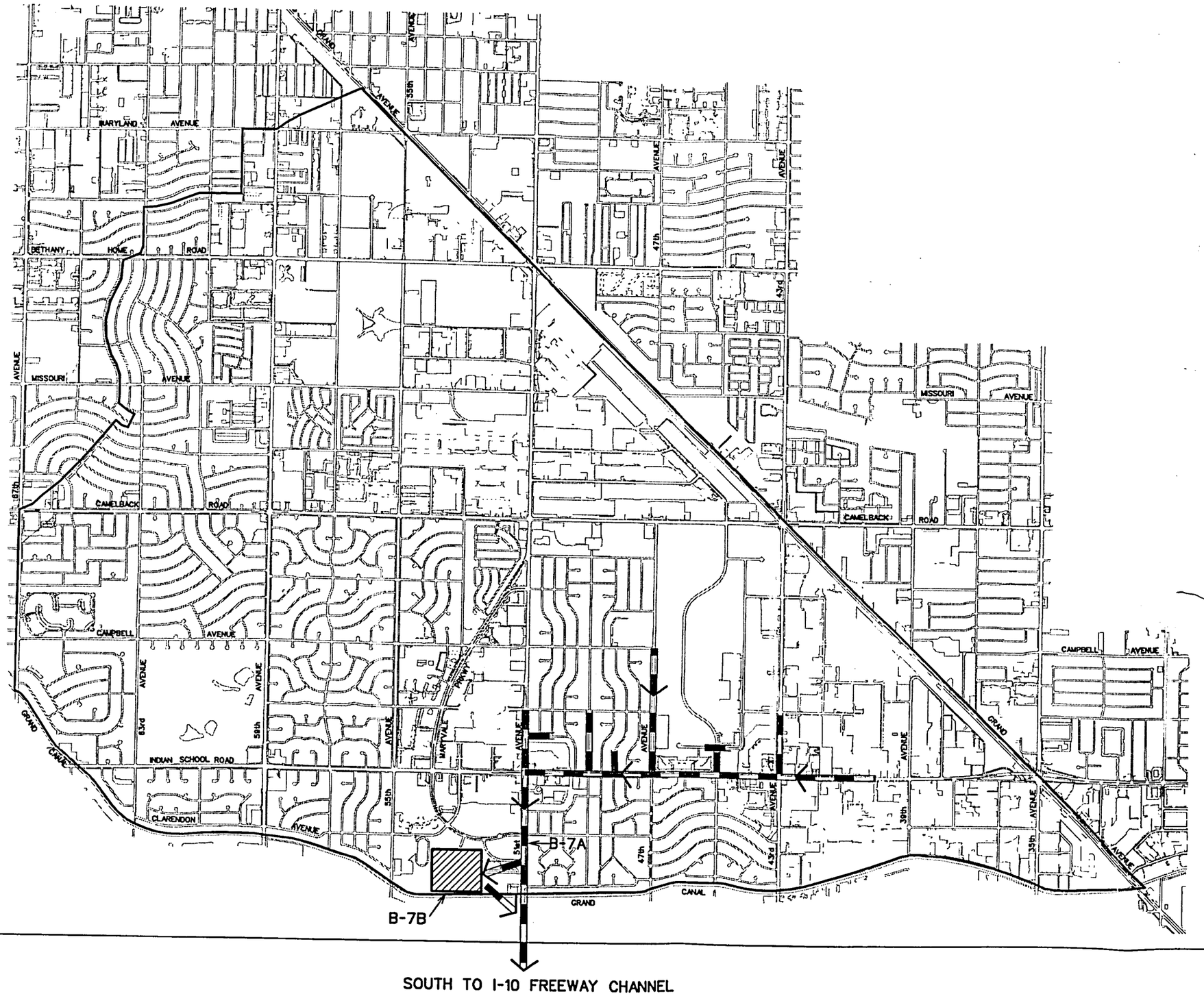
Coe & Van Loo Consultants, Inc.



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF
MARYVALE
FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

CONCEPTUAL FLOOD CONTROL ALTERNATIVES

ALTERNATIVE B-7

LEGEND

Channel / Storm Drain

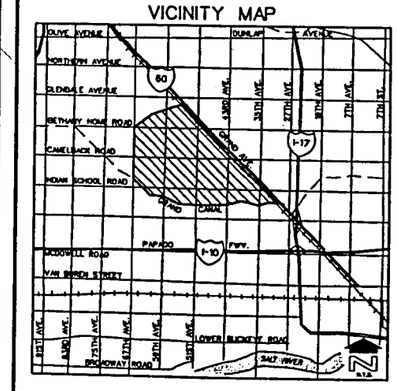
Detention Basin

OPTION

A Drainage Interceptor to Drain South

B Offline Detention Basin

VICINITY MAP



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SCALE IN FEET
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COE & VAN LOO, INC.

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SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

PLATE B-7

JOB NO. 950024

DATE: JUL 19, 1995
TIME: 9:50:59
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LV-7

ALTERNATIVE B-8

ALTERNATIVE B-8

Construct a linear detention basin on the north side of the Grand Canal. This basin would: (1) Remove the first row of houses adjacent to the canal, (2) Remove the first row of houses, Crittenden Lane, and the second row of houses, (3) Lie on the north side of a relocated section of the Grand Canal, or (4) A combination of two of these options. The detention basin would outlet to the existing 43rd Avenue or 51st Avenue storm drain.

Pros

- Provide adequate protection.
- Possible secondary use as City park.
- Enhances usefulness of existing storm drains.

Cons

- Displaces more homeowners than any other alternative. (If the Grand Canal stays where it is.)
- SRP may not want the canal moved to provide room for the basin.
- Hardship to those who have to move for construction of the basin.
- High maintenance costs for a park.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B-8

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
	160 AF	Detention Basin Along Grand Canal	258,000	CY	$3.00	$774,000
		Demolition	170	EA	$5,000.00	$850,000
		Landscape Restoration	12	AC	$40,000.00	$480,000
		72" RGRCP Storm Drain Outfall	100	LF	$175.00	$17,500

Subtotal	$2,121,500
Engineering & Contingencies @ 40%	$848,600
Land Acquisition	$10,255,000
Surveying & Other Acquisition Costs @ 20%	$2,051,000
TOTAL PROJECT BUDGET	$15,276,100

Note:

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Coe & Van Loo Consultants, Inc.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF

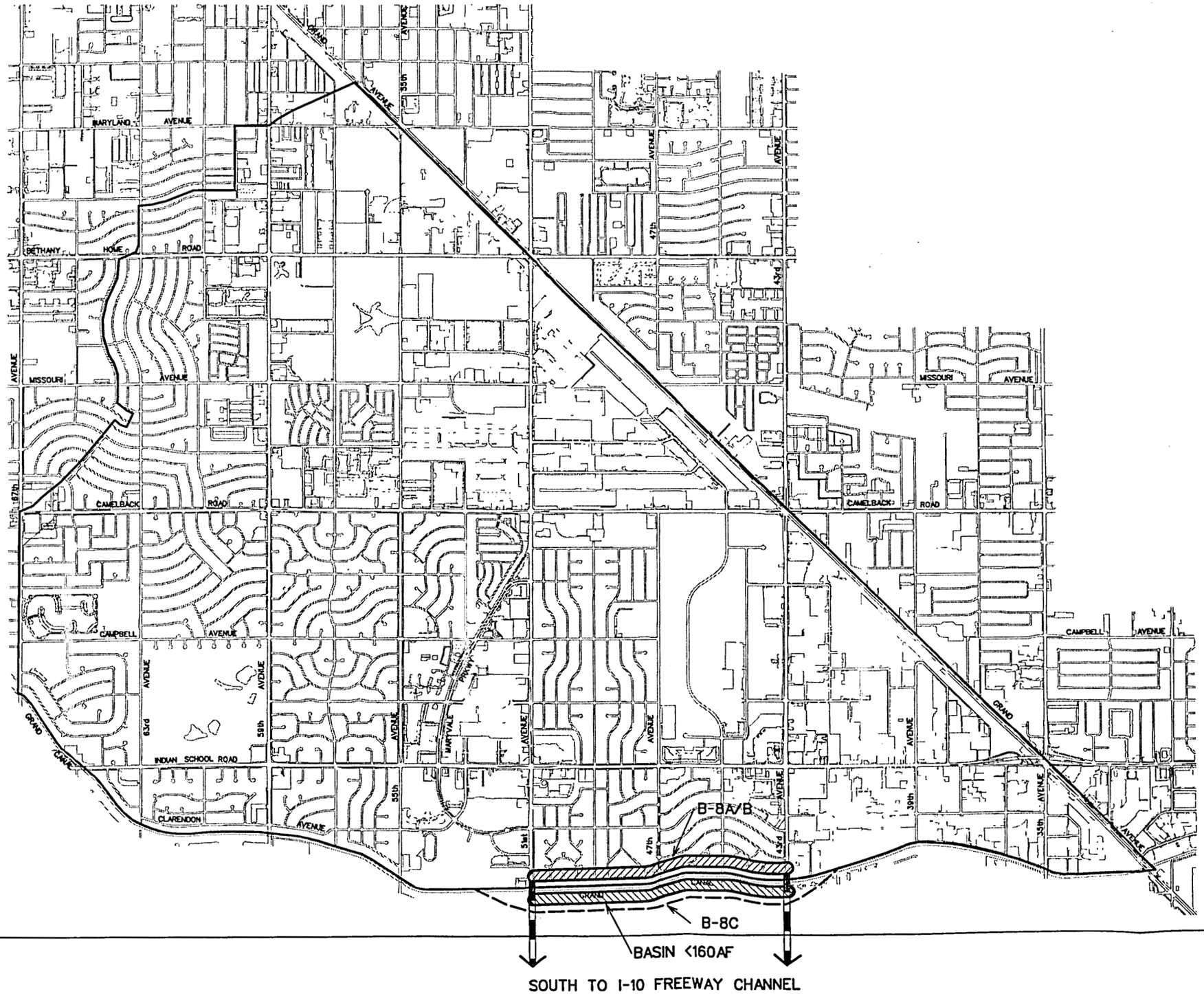
MARYVALE

FLOODING MITIGATION PROJECT

F.C.D. CONTRACT NO. 93-94

CONCEPTUAL FLOOD CONTROL ALTERNATIVES

ALTERNATIVE B-8



LEGEND

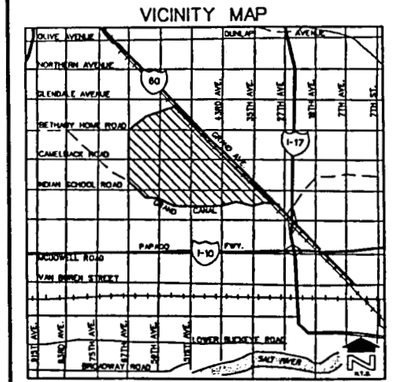
Channel / Storm Drain

Detention Basin

OPTION

A	Strip Basin Along Canal
B	Strip Basin Along Interior Streets
C	Relocate Canal to South

VICINITY MAP



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CONTOUR INTERVAL = 10' FEET

COE & VAN LOO, INC.

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SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

PLATE B-8

JOB NO. 950024

DATE:- JUL 18, 1995
TIME:- 09:30
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LV=8

ALTERNATIVE B-9

ALTERNATIVE B-9

Construct a detention basin on the southwest corner of Camelback Avenue and 43rd Avenue to intercept flows that cross Grand Avenue in the 60-inch storm drain. The basin would outlet to the 43rd Avenue storm drain.

Pros	Cons
• Provides relief to 43rd Avenue storm drain system.	• Does not provide 100-year protection.
• Intercepts upstream flow before it reaches Area B.	• Maintenance costs for an unimproved detention basin.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B-9

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
	350 AF	Detention Basin Excavation	565,000	CY	$3.00	$1,695,000
		72" RGRCP	500	LF	$175.00	$87,500
		Fencing & Screening	6,300	LF	$26.00	$163,800

Subtotal	$1,946,300
Engineering & Contingencies @ 40%	$778,520
Land Acquisition	$3,970,000
Surveying & Other Acquisition Costs @ 20%	$794,000
TOTAL PROJECT BUDGET	**$7,488,820**

Note:

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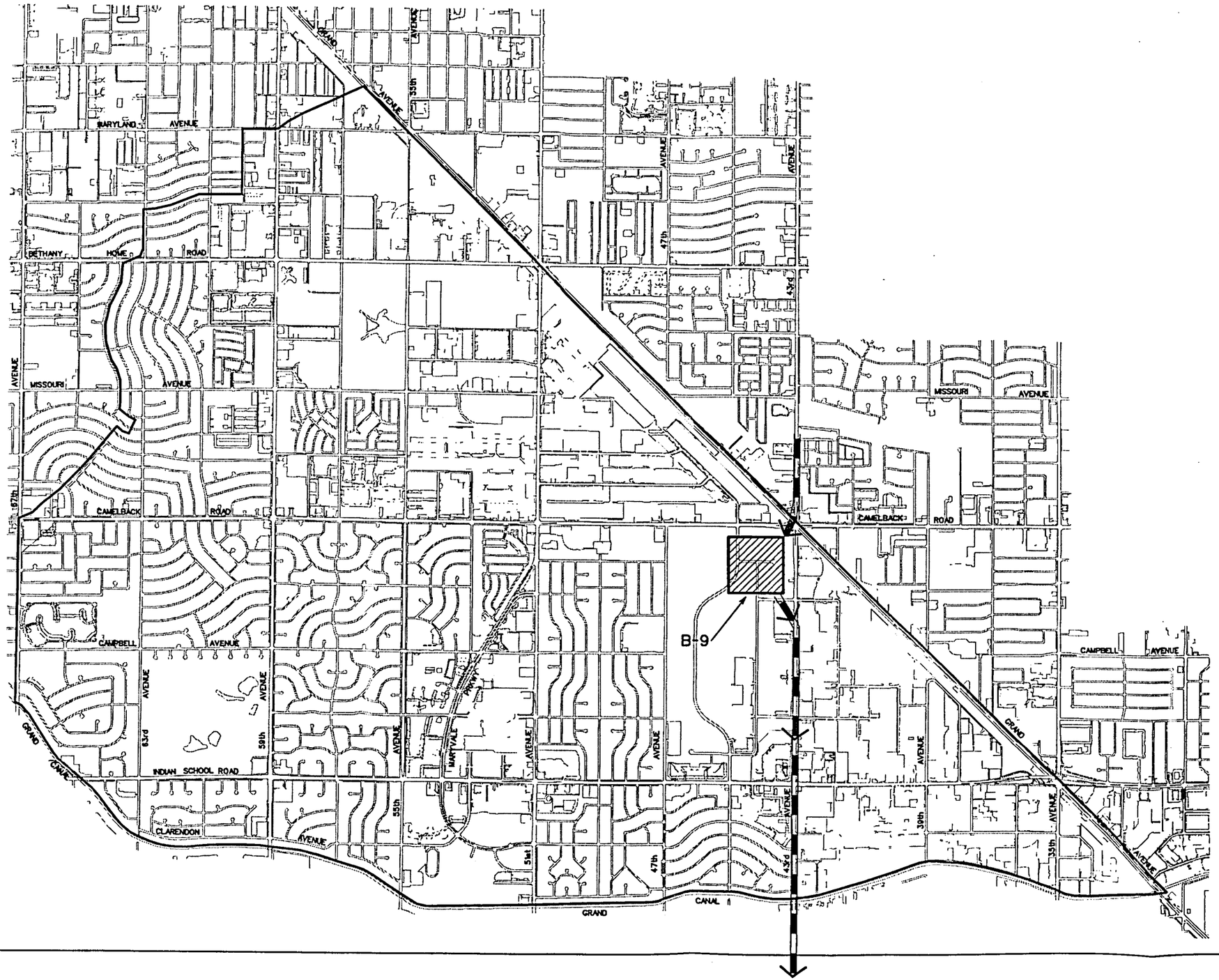
Coe & Van Loo Consultants, Inc.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF
MARYVALE
FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

CONCEPTUAL FLOOD CONTROL ALTERNATIVES

ALTERNATIVE B-9

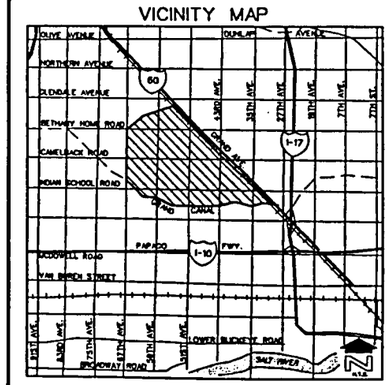


LEGEND

Channel / Storm Drain

Detention Basin

VICINITY MAP



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CONTOUR INTERVAL = 10' FEET

COE & VAN LOO, INC.

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PLANS	PJE	
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SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

PLATE B-9

JOB NO. 950024

DATE: JUL 19, 1995
TIME: 10:36:49
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LV-29

ALTERNATIVE B-10

ALTERNATIVE B-10

Construct a detention basin in Marivue Park, south of the canal near 55th Avenue. Construct an interceptor channel or storm drain along the north side of the Grand Canal. Bleed off the basin into the 59th Avenue storm drain.

Pros	Cons
• Provides 100-year level of protection.	• Requires upstream storm drains to collect storm runoff. • May be difficult to construct another crossing of the Grand Canal. • Hardship to those residents who have to move. • City Parks Department may not allow use of City park as detention basin. • Cost of park restoration is high. • Park is out of service during construction and restoration. • Slightly higher maintenance costs than those of the existing park.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B-10

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
	157 AF	Detention Basin in Maryvue Park	253,000	CY	$3.00	$759,000
		Channel Excavation	16,500	CY	$3.00	$49,500
		4-10'x8' CBC	2,600	LF	$986.00	$2,563,600
		Concrete B.P. (6" thick)	2,800	CY	$280.00	$784,000
		Demolition	39	EA	$5,000.00	$195,000
		Park Restoration	40	AC	$80,000.00	$3,200,000

Subtotal	$7,551,100
Engineering & Contingencies @ 40%	$3,020,440
Land Acquisition	$2,094,000
Surveying & Other Acquisition Costs @ 20%	$418,800
TOTAL PROJECT BUDGET	$13,084,340

Note:

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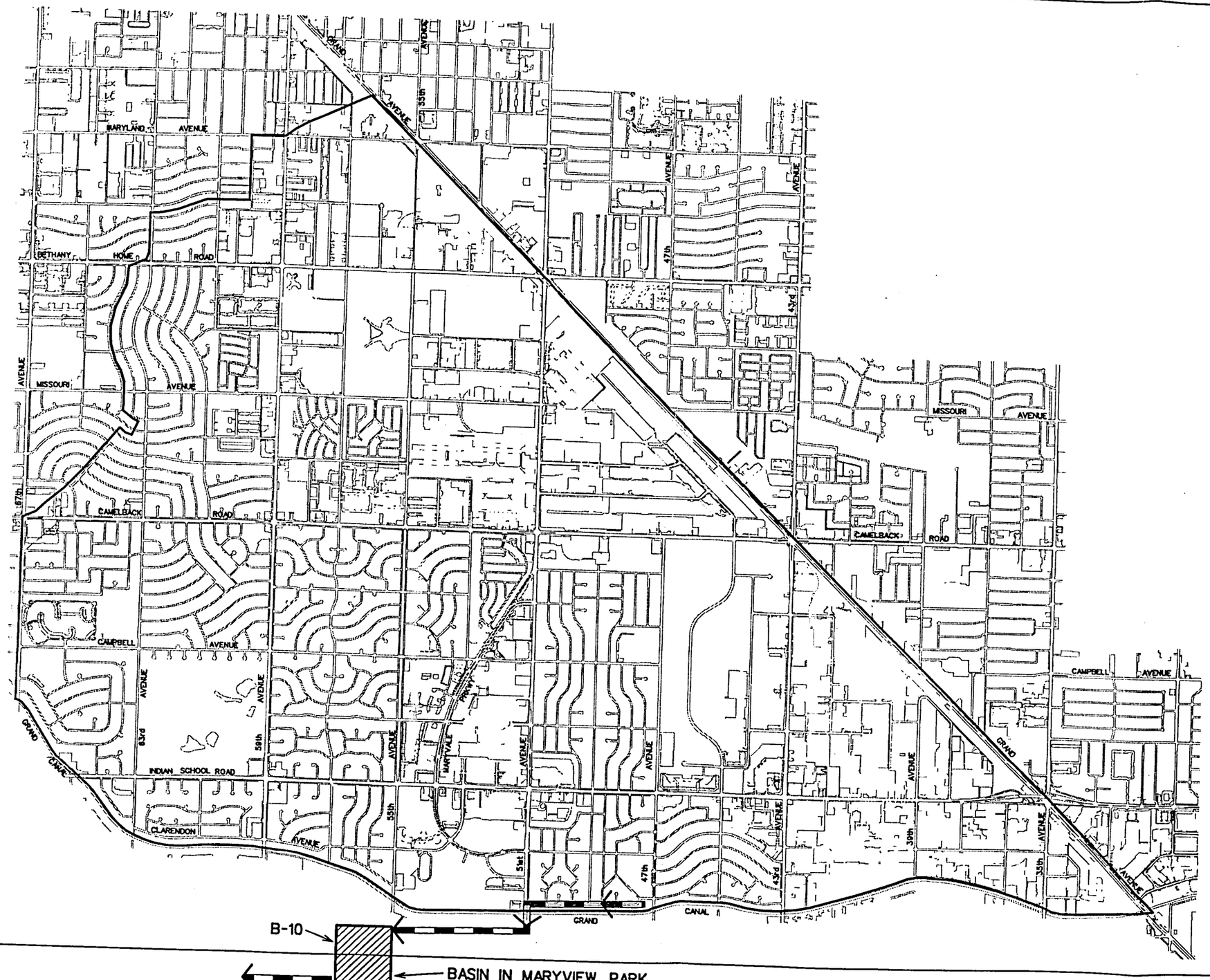
Coe & Van Loo Consultants, Inc.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF
MARYVALE
FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

CONCEPTUAL FLOOD CONTROL ALTERNATIVES

ALTERNATIVE B-10

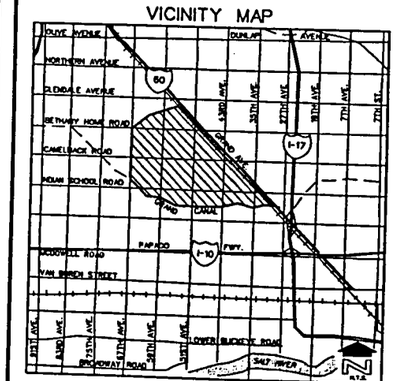


LEGEND

Channel / Storm Drain

Detention Basin

VICINITY MAP



1000 0' 1000 2000

SCALE IN FEET
CONTOUR INTERVAL = 10' FEET

COE & VAN LOO, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

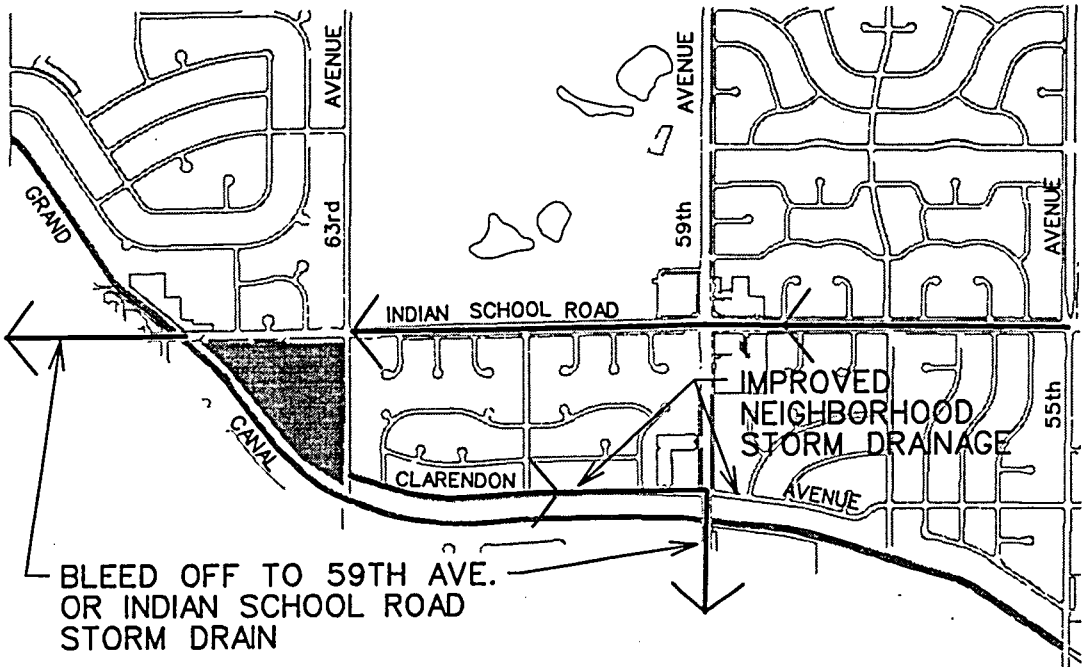
PLATE B-10

JOB NO. 950024

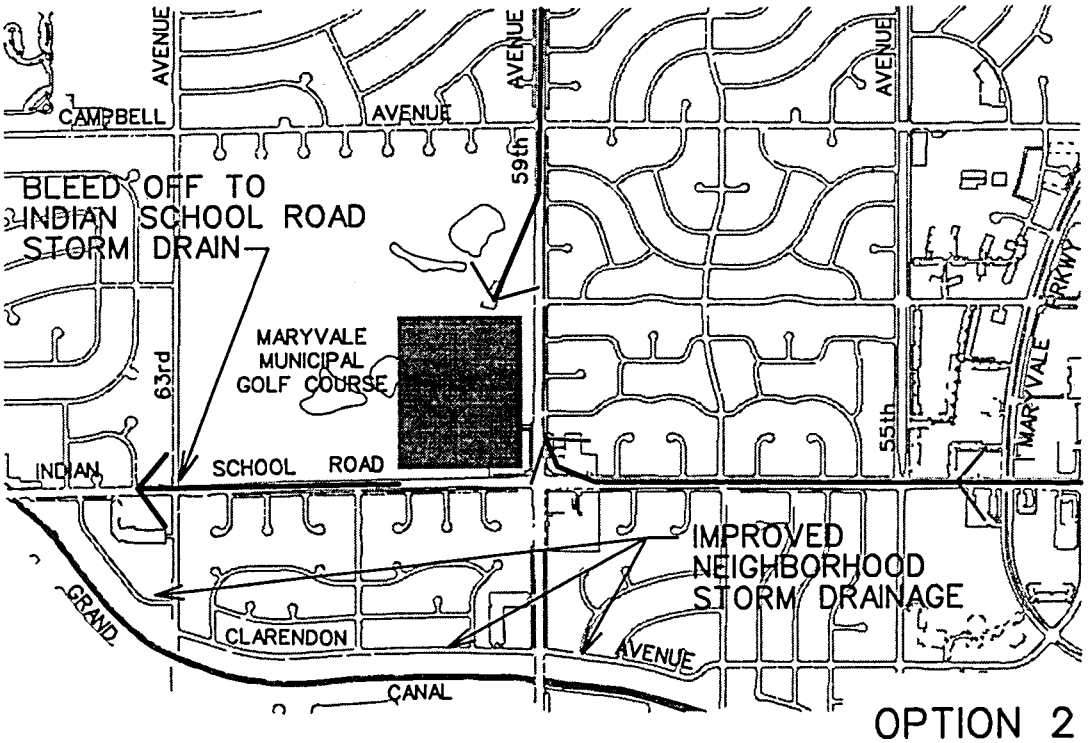
DATE: July 19, 1995
TIME: 10:36:18
FILE: q:\950024\hydro\altmap.dgn

LV-15

APPENDIX IV
DESIGN OPTIONS



OPTION 1
(ALT. A5)



OPTION 2
(ALT. A4-2)

N.T.S.

JOB NO. 95-0024

MARYVALE
FLOODING MITIGATION PROJECT

AREA 'A' 100-YEAR FLOOD PROTECTION

PLATE A
100-YEAR

CVL

FILE: ALTA.DGN (SCALE: 1400)

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE A5

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1	274 AF	Detention Basin Excavation	442,000	CY	$3.00	$1,326,000
		24" RGRCP	2,640	LF	$60.00	$158,400
		42" RGRCP	1,400	LF	$105.00	$147,000
		54" RGRCP	1,400	LF	$125.00	$175,000
		108" RGRCP	8,480	LF	$295.00	$2,501,600
		114" RGRCP	1,200	LF	$305.00	$366,000
		120" RGRCP	3,000	LF	$315.00	$945,000
		144" RGRCP	1,300	LF	$365.00	$474,500
		Demolition (35 residences, 1 Church & 1 Fire Station)	1	LS	$221,000.00	$221,000
		Land Restoration	23	AC	$40,000.00	$920,000

Subtotal	$7,234,500
Engineering & Contingencies @ 40%	$2,893,800
Land Acquisition	$7,947,000
Surveying & Other Acquisition Costs @ 20%	$1,589,400
TOTAL PROJECT BUDGET	$19,664,700

Note: These cost estimates have been developed as a part of a preliminary submittal dated 9/29/95 Estimates are provided for the purposes of comparison only and are not intended to reflect an engineering estimate of the final construction cost. All costs are based upon a 1995 datum.

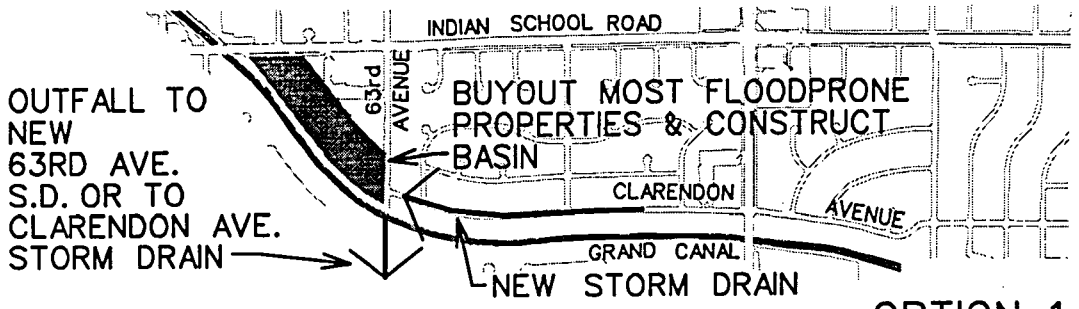
Coe & Van Loo Consultants, Inc.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE A4-2

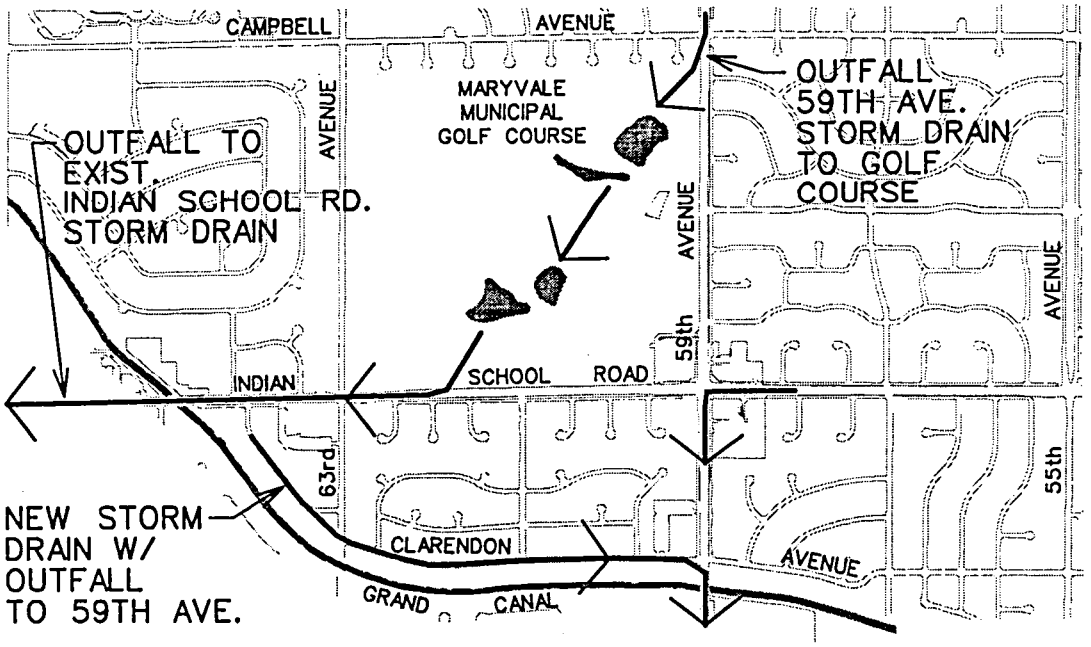
Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1	229 AF	Detention Basin Excavation	370,000	CY	$3.00	$1,110,000
		24" RGRCP	4,000	LF	$60.00	$240,000
		42" RGRCP	1,400	LF	$105.00	$147,000
		54" RGRCP	1,400	LF	$125.00	$175,000
		66" RGRCP	1,000	LF	$140.00	$140,000
		72" RGRCP	3,300	LF	$160.00	$528,000
		108" RGRCP	1,200	LF	$305.00	$366,000
		114" RGRCP	1,200	LF	$305.00	$366,000
		126" RGRCP	1,700	LF	$325.00	$552,500
		144" RGRCP	3,000	LF	$365.00	$1,095,000
		Golf Course Restoration	55	AC	$80,000.00	$4,400,000
		Subtotal				$9,119,500
		Engineering & Contingencies @ 40%				$3,647,800
		Land Acquisition				$0
		Surveying & Other Acquisition Costs @ 20%				$0
		TOTAL PROJECT BUDGET				$12,767,300

Note: These cost estimates have been developed as a part of a preliminary submittal dated 9/29/95 Estimates are provided for the purposes of comparison only and are not intended to reflect an engineering estimate of the final construction cost. All costs are based upon a 1995 datum.

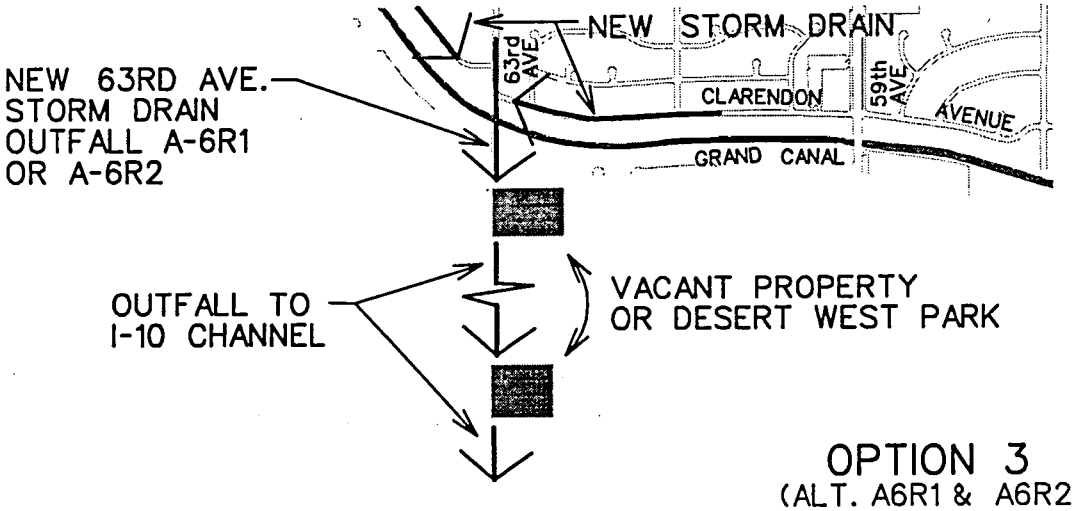
Coe & Van Loo Consultants, Inc.



OPTION 1
(ALT. A5R)



OPTION 2
(ALT. A4R)



OPTION 3
(ALT. A6R1 & A6R2)

N.T.S.

JOB NO. 95-0024

MARYVALE FLOODING MITIGATION PROJECT

AREA 'A' LOWER LEVEL PROTECTION

PLATE A
LOWER LEVEL

CVL

FILE: ALTA2.DGN (SCALE:1400)

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE A5R
Option 1

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
	100 cfs	60" RGRCP Clarendon Ave. S.D.	2,600	L.F.	$133.00	$345,800
		s=0.2%				
		Detention Basin Excavation	58,000	C.Y.	$3.00	$174,000
	9 cfs	24" RGRCP outfall to 59th Ave.	2,500	L.F.	$60.00	$150,000
		via Clarendon				
		Revegetation	8	Ac	$40,000.00	$320,000
		Structure Demolition	37	Ea.	$5,000.00	$185,000

Subtotal	$1,174,800
Engineering & Contingencies @ 40%	$469,920
Land Acquisition	$1,775,100
Surveying & Other Acquisition Costs @ 20%	$355,020
TOTAL PROJECT BUDGET	$3,774,840

Note:

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MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE A4R
Option 2

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
	100 cfs	60" RGRCP in Clarendon	4,000	LF	$133.00	$532,000
		s=0.2%				
	100 cfs	24" RGRCP connecting outfall from golf	650	LF	$60.00	$39,000
		course to exist. Indian School S.D.				
		Golf Course Grading & Reveg.	23	AC	$80,000.00	$1,840,000

Subtotal	$2,411,000
Engineering & Contingencies @ 40%	$964,400
Land Acquisition	
Surveying & Other Acquisition Costs @ 20%	$0
TOTAL PROJECT BUDGET	$3,375,400

Note:

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Coe & Van Loo Consultants, Inc.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE A6R1
Option 3

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
	100 cfs	60" RGRCP in Clarendon	4,000	LF	$133.00	$532,000
		s=0.2%				
	100 cfs	60" RGRCP in 63rd Ave.	5,280	LF	$133.00	$702,240
		s=0.2%				
		5' Detention Basin w/3:1 sides in	90,000	CY	$3.00	$270,000
		Desert West Park				
	9 cfs	24" RGRCP outfall in 63rd Ave. to I-10 chl	4,570	LF	$60.00	$274,200
		s=0.2%				
		Perimeter Fencing	4,000	LF	$26.00	$104,000

Subtotal	$1,882,440
Engineering & Contingencies @ 40%	$752,976
Land Acquisition	
Surveying & Other Acquisition Costs @ 20%	$0
TOTAL PROJECT BUDGET	$2,635,416

Note:

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Coe & Van Loo Consultants, Inc.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE A6R2
Option 3

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
	100 cfs	60" RGRCP in Clarendon	4,000	LF	$133.00	$532,000
		s=0.2%				
	100 cfs	60" RGRCP in 63rd Ave.	550	LF	$133.00	$73,150
		s=0.2%				
		8' Detention Basin w/3:1 sides in	47,600	CY	$3.00	$142,800
		Vacant Lot				
	26 cfs	36" RGRCP outfall in 63rd Ave. to I-10	9,300	LF	$90.00	$837,000
		s=0.2%				
		Perimeter Fencing	1,800	LF	$26.00	$46,800

Subtotal	$1,631,750
Engineering & Contingencies @ 40%	$652,700
Land Acquisition	$238,620
Surveying & Other Acquisition Costs @ 20%	$47,724
TOTAL PROJECT BUDGET	$2,570,794

Note:

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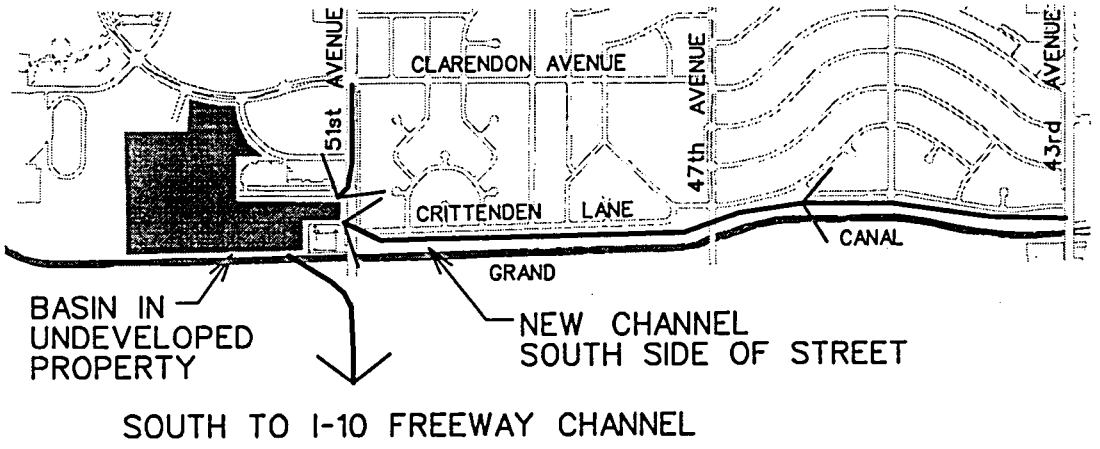
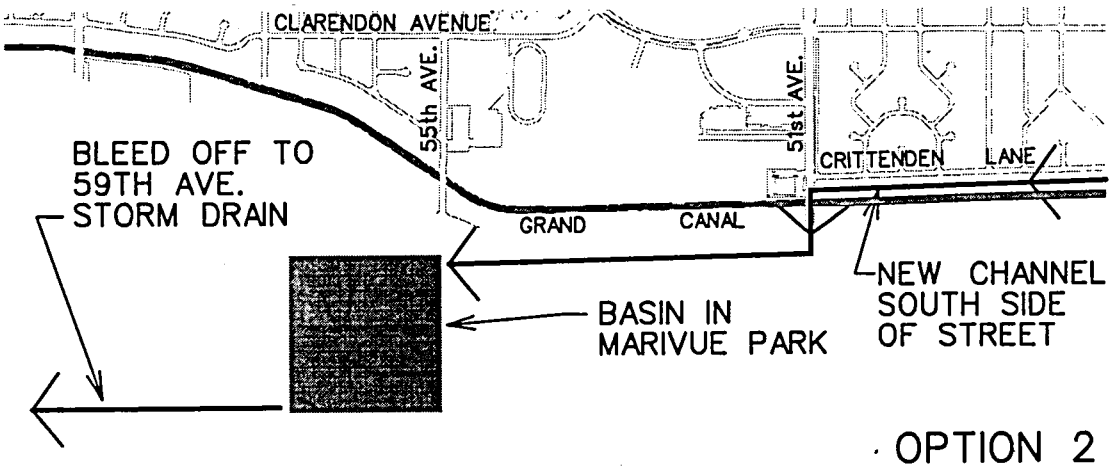
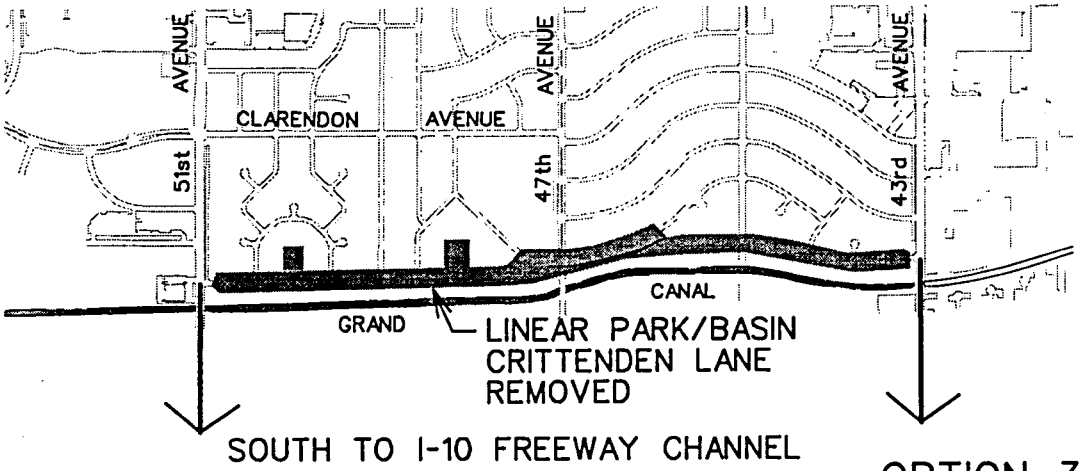
Coe & Van Loo Consultants, Inc.



OPTION 1
(ALT. B6)



OPTION 2
(ALT. B10)



OPTION 3
(ALT. B8)

N.T.S.

JOB NO. 95-0024

FILE: ALTB.DGN (SCALE: 1400)

MARYVALE FLOODING MITIGATION PROJECT

AREA 'B' 100-YEAR PROTECTION

PLATE B
100-YEAR

CVL

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B6

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1	119 AF	Detention Basin Excavation	192,000	CY	$3.00	$576,000
		at Grand Canal & 53rd Ave.				
		Channel Excavation	33,000	CY	$3.00	$99,000
		Concrete Channel Paving (6" thk)	5,600	CY	$280.00	$1,568,000
		72" RGRCP	11,000	LF	$160.00	$1,760,000
		Demolition	77	EA	$5,000.00	$385,000
		Fencing & Screening	4,600	LF	$26.00	$119,600

Subtotal	$4,507,600
Engineering & Contingencies @ 40%	$1,803,040
Land Acquisition	$7,421,000
Surveying & Other Acquisition Costs @ 20%	$1,484,200
TOTAL PROJECT BUDGET	**$15,215,840**

Note: These cost estimates have been developed as a part of a preliminary submittal dated 9/29/95 Estimates are provided for the purposes of comparison only and are not intended to reflect an engineering estimate of the final construction cost. All costs are based upon a 1995 datum.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B-10

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
	157 AF	Detention Basin in Maryview Park	253,000	CY	$3.00	$759,000
		Channel Excavation	22,000	CY	$3.00	$66,000
		4-10'x8' CBC	2,600	LF	$986.00	$2,563,600
		Concrete B.P. (6" thick)	3,800	CY	$280.00	$1,064,000
		Demolition	39	EA	$5,000.00	$195,000
		Park Restoration	40	AC	$80,000.00	$3,200,000

Subtotal	$7,847,600
Engineering & Contingencies @ 40%	$3,139,040
Land Acquisition	$2,094,000
Surveying & Other Acquisition Costs @ 20%	$418,800
TOTAL PROJECT BUDGET	$13,499,440

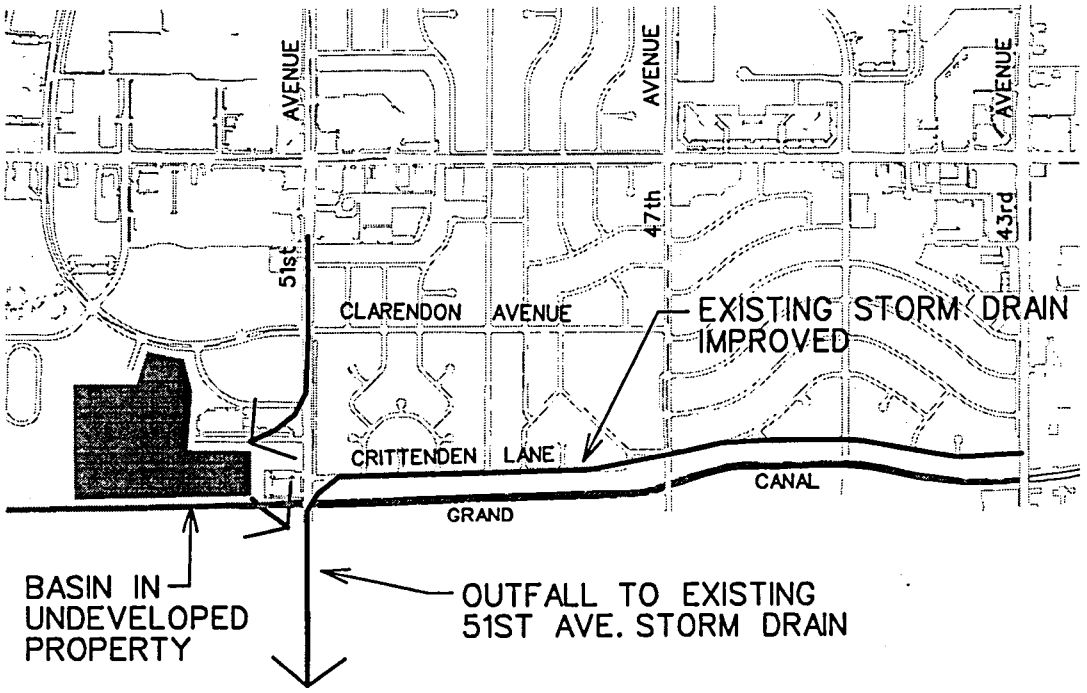
Note: These cost estimates have been developed as a part of a preliminary submittal dated 9/29/95 Estimates are provided for the purposes of comparison only and are not intended to reflect an engineering estimate of the final construction cost. All costs are based upon a 1995 datum.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B-8

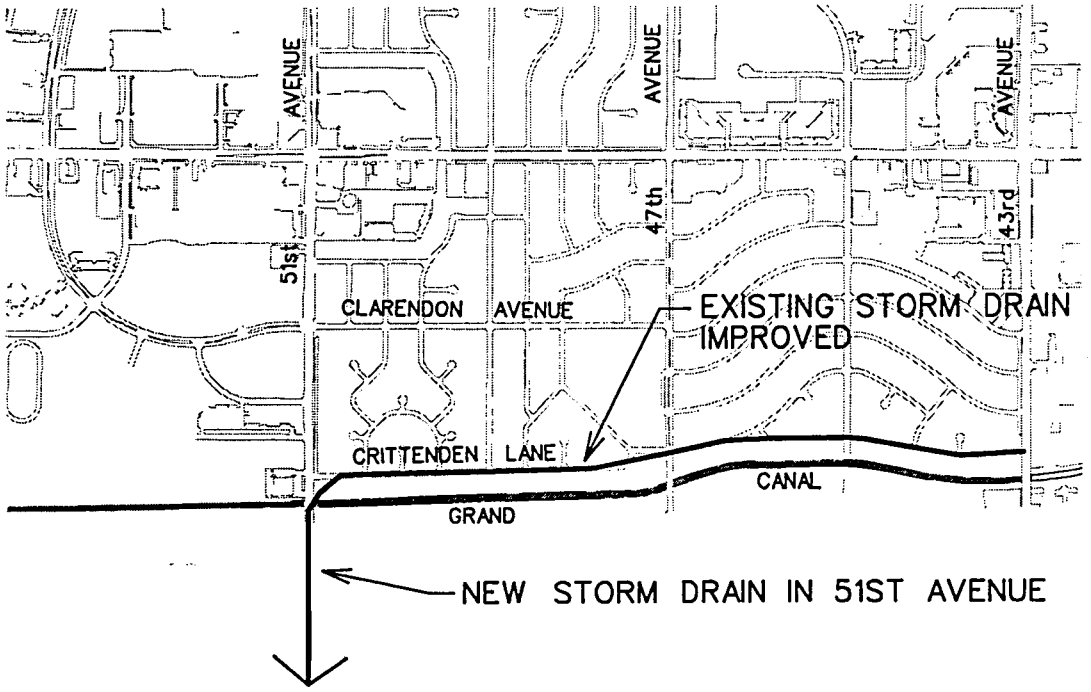
Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
	160 AF	Detention Basin Along Grand Canal	258,000	CY	$3.00	$774,000
		Demolition	170	EA	$5,000.00	$850,000
		Landscape Restoration	12	AC	$40,000.00	$480,000
		72" RGRCP Storm Drain Outfall	500	LF	$175.00	$87,500

Subtotal	$2,191,500
Engineering & Contingencies @ 40%	$876,600
Land Acquisition	$10,255,000
Surveying & Other Acquisition Costs @ 20%	$2,051,000
TOTAL PROJECT BUDGET	$15,374,100

Note: These cost estimates have been developed as a part of a preliminary submittal dated 9/29/95 Estimates are provided for the purposes of comparison only and are not intended to reflect an engineering estimate of the final construction cost. All costs are based upon a 1995 datum.



OPTION 1
(ALT. B6R)



OPTION 2
(ALT. B4R)

N.T.S.

JOB NO. 95-0024

MARYVALE FLOODING MITIGATION PROJECT

AREA 'B' LOWER LEVEL PROTECTION

PLATE B
LOWER LEVEL

CYL

FILE: ALTB2.DGN (SCALE: 1400)

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B6R
Option 1

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
		55.54 Ac Parcel Acquisition				
	74 A.F	Basin Excavation + 1' freeboard	144,000	C.Y.	$3.00	$432,000
		24" RGRCP bleed pipe	200	LF	$55.00	$11,000
		54" RGRCP storm drain	5,300	CY	$125.00	$662,500
		Fencing & Screening	2,800	LF	$26.00	$72,800

Subtotal	$1,178,300
Engineering & Contingencies @ 40%	$471,320
Land Acquisition	$3,232,448
Surveying & Other Acquisition Costs @ 20%	$646,490
TOTAL PROJECT BUDGET	$5,528,558

Note:

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Coe & Van Loo Consultants, Inc.

MARYVALE FLOODING MITIGATION PROJECT
ALTERNATIVE B4R
Option 2

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
	150 cfs	54" S.D. Outfall in Crittenden	5,300	L.F.	$125.00	$662,500
		54" S.D. outfall in 51st Ave.	9,240	L.F.	$125.00	$1,155,000

Subtotal	$1,817,500
Engineering & Contingencies @ 40%	$727,000
Land Acquisition	
Surveying & Other Acquisition Costs @ 20%	$0
TOTAL PROJECT BUDGET	$2,544,500

Note:

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Coe & Van Loo Consultants, Inc.

MARYVALE FLOODING MITIGATION PROJECT
Knuckle at 56th Ave. & Whitton Ave.

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
		54" RGRCP, cul-de-sac to channel	150	LF	$125.00	$18,750
		60" RGRCP @ 55th Ave. to Basin B-6	1,000	LF	$133.00	$133,000
		Landscape & Wall Reconstruction	1	LS	$20,000.00	$20,000
		Regrade Exist. Channel	6,000	CY	$5.00	$30,000

Subtotal	$201,750
Engineering & Contingencies @ 40%	$80,700
Land Acquisition	$0
Surveying & Other Acquisition Costs @ 20%	$0
TOTAL PROJECT BUDGET	$282,450

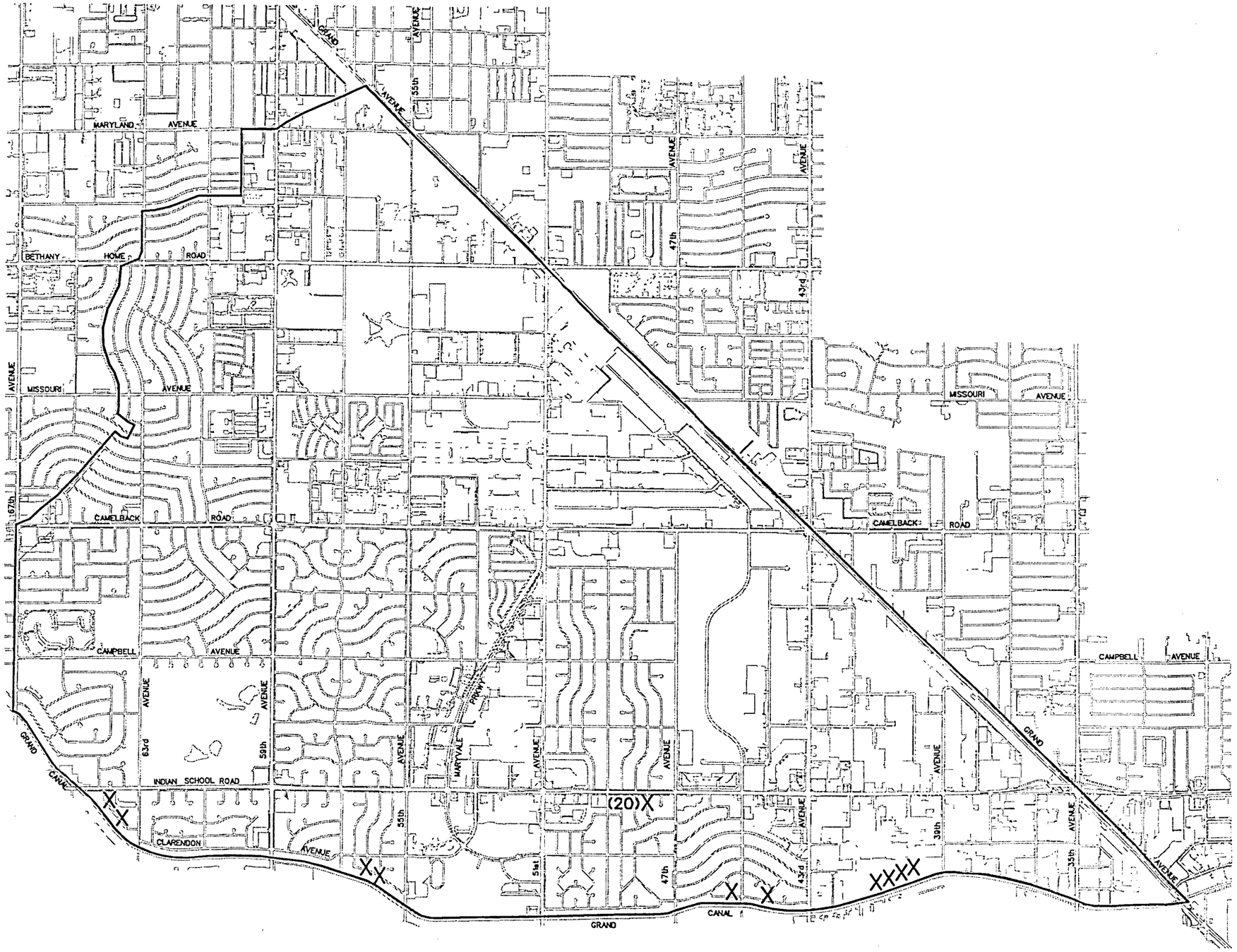
Note:

Estimates are provided for the purposes of comparison only and are not intended to reflect an engineering estimate of the final construction cost. All costs are based upon a 1995 datum.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF
MARYVALE
FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

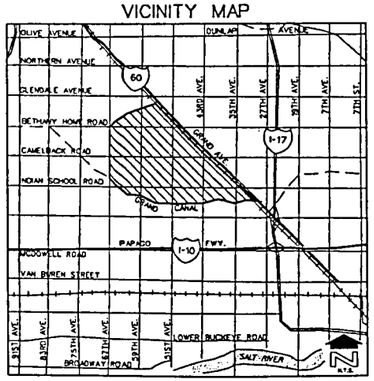
CITY OF PHOENIX REPORTED FLOODING LOCATIONS



LEGEND

X	Reported Flooding
(20)	Location Number of Known Affected Structures (if more than 1)

VICINITY MAP



1000 0' 1000 2000

SCALE IN FEET
CONTOUR INTERVAL - 10' FEET

CVL COE & VAN LOO CONSULTANTS, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

JOB NO. 950024

LV-30

DATE:- Jul 19, 1993
TIME:- 13:36:18
FILE:- e:\950024\hydro\altmap.dgn

Flood Control District of Maricopa County
2801 W. Durango Street
Phoenix, AZ 85009
(602) 506-1501 *FAX: (602) 506-4601*

Maryvale Flooding Mitigation Project

The Flood Control District of Maricopa County and the City of Phoenix are planning a project(s) for the Maryvale area that will provide relief to some flooding and drainage problems. We are interested in hearing your views and concerns about such a project in the Maryvale area.

Please take the time to fill out this form. Your input will help the Flood Control District and City of Phoenix work together to develop a solution beneficial to the community. The address is on the back of this sheet, so you may fold and fasten it and drop it in the mail at your convenience.

☞ **Si usted tiene problemas de inundación, por favor llame al teléfono (602) 506-1501 para información *en español.* Pregunte por Margarita Bejarano.**

How long have you lived in your home? _____ Years _____ Months

Have you had flooding in your area? _____ Yes _____ No

- **Did floodwater come from water spilling out of the canal?** _____ Yes _____ No
- **Was flooding caused by water ponding against the canal?** _____ Yes _____ No

Was water inside your home? _____ Yes _____ No

- **If yes, how many times has your home flooded?** _____
- **How deep?** _____
- **Cost of damage?** _____

When did the flooding last occur? _____

Can you list dates or years of any other flood events? _____

Were you unable to get to or from your home because of flooding? _____ Yes _____ No

Do you have flood insurance? _____ Yes _____ No

- **What are your major concerns and interests in flood control and drainage improvements?**

_____

_____

☐ Check here if you don't mind if we contact you.

Name: _____ Phone: _____

Address: _____

_____

Felicia Terry, P.E
Project Manager

Sandy Walchuk
Public Involvement Coordinator

Maryvale Flooding Mitigation Project Survey

NAME	ADDRESS	ZIP	PHONE	YEARS AT YOUR HOM	FLOODING IN YOUR AREA?	SPILLED OUT OF CANAL	PONDING AGAINST CANAL	WAS WATER IN YOUR HOME?	HOW MANY TIMES	DEPTH	DAMAGE	LAST FLOOD	DATES OF LAST FLOODING	UNABLE TO ACCESS HOME?	DO YOU HAVE FLOOD INSURANCE	MAY WE CONTACT YOU?	COMMENTS
																	City will provide some source of protection.
Thompson, Gerald A..	5621 W. Whitton Avenue	85031	247-2705	39.5	Yes		Yes	Yes	6	2-4 in	$4,000	Jul-92	58,60,70,85,89,	Yes	No	Yes	
Campbell, Larry	6224 W. Clarendon	85033	846-5939	16	Yes		Yes	Yes	4								
				34	Yes	Yes	No	No	3			1980/1985		Yes	No		
Hamm, Edward & Zella	5807 W. Clarendon	85031	247-5154	19	Yes	Yes	No	Yes	3	5in	$9,000	1993		Yes	Yes	Yes	
Freeman, John	4541 W. Crittenden Lane	85031	278-4530	17.6	Yes	No	Yes	Yes	1	12-14in	12,000	Jul-92		Yes	Yes	Yes	Keep the storm drain cleaned out.
Hand, Clyde W. Betty J.	4511 W. Crittenden Lane	85031	272-3719	27.8	Yes	No	Yes	Yes	2	18-2ft	6,000	Jul-92	Mar-00	Yes	No	Yes	To have proper drain pipes.
Brown, Marilyn			848-5305	30.3	Yes	Yes	Yes									No	
Livingston, James W.	6129 W. Clarendon	85033	846-9962	7.5	No	No	No	No						No	Yes	Yes	To reduce my insurance costs.
Nichols, C.B.	6101 W. Indianola	85033	849-9410	18	No	No	No	No						No	No		None
				4.4	No	No	No	No				None		No	Yes		
Medaglia, Thomas	6035 W. Indianola	85033		25	No	No	No	No						No	Yes	Yes	We are forced to pay flood insurance.
Ritchey, L.	5511 W. Weldon Avenue	85031	247-5899	38	No	No	No	No				None					
Ulloa, Jose & Pauline	3437 N. 49th Drive	85031	247-8339	2.4	No	No	No	No						No	Yes	Yes	
Miller, Mark & Rosemary	4633 W. Whitton Avenue	85031	278-5477	18	Yes	No	Yes	No				1993			Yes	Yes	Little/No drainage in area.
Ornelas, Guadalupe	4639 W. Mitchell	85031	269-9340	9	Yes	No	Yes	No					93,94	Yes	Yes	Yes	
Mullins, Ken & Connie	4931 W. Crittenden	85031	245-1417	28.1	No	No	No	No						No	Yes	Yes	Clean out the drains.
Moses, Lois	3601 N. 48th Drive	85031	247-8719	22	No	No	No	No						No	No	Yes	
	4318 N. 66th Drive	85033	847-2238	33	Yes	No	No	No				1967		No	No		Taken care of.
Lewis, Robert	3808 N. 57th Avenue	85031	247-2625	37.3	Yes	No	Yes	No	0					No	Yes	Yes	
Smotherman, John F.	4128 N. 64th Drive	85033	846-2393	30.3	Yes	Yes	No	No				75		No	No	Yes	
Lambert, W.	6005 W. Indianola Avenue	85033		26.8	No			No						No	No	No	
Gulick, Robert & Elaine	3820 N. 55th Drive	85031	247-2762	25.3	Yes	No	No	No						Yes	No		More drainage sewers - now inadequate.
Selby, Joan M.	4541 W. Whitton Avenue	85031	272-4711	40.3	Yes	Yes		No						Yes	No	Yes	
Miller, Richard G.	4549 W. Whitton Avenue	85031	272-1667	37.4	No								91	No	Yes		Damage to property/homes if steps aren't taken.
Barreras, Pat	3634 N. 55th Drive	85031	247-0756	7	No	No	No	No						Yes	Yes	Yes	Drains always plugges on 55th Dr/Whitton
Bednared, David	5759 W. indianola Avenue	85031	245-2542	6	Yes	No	No	No				1992/1993			Yes	Yes	Inadequate storm sewers.
Garcia, Alejandro	6101 W. Clarendon Avenue	85033	848-6479	3.1	No			No							Yes	Yes	
	3819 N. 56th Avenue	85031		38	No										No		
Cancino, Miguel	4951 W. Crittenden		247-4130	19.7	Yes	No	No	Yes	1	3in	1,500	1977		No	Yes	Yes	Not enough catch basins into storm drains.
Palmer, Mollie	4745 W. Mitchell Drive	85031	248-8247	27.6	No	No		No							No	Yes	
Smith, Donna	4737 W. Crittenden Lane	85031	245-9453	20	Yes	No	No	No						No	Yes	Yes	
				9.6	No	No	No	No						No	Yes		
King, John	3439 N. 51st Avenue	85031	247-7141	14	Yes	No	No	No						No	No	Yes	
Morrison, Rodney	6023 W. Indianola Avenue	85033	848-9870	34.5	No										No		Concerned about paying for insurance as a renter.
Martinez, Vincente C.	5936 W. Clarendon	85033		5	No	No	No	No						Yes	Yes		
Wills, Ronald	3602 N. 55th Avenue		247-1512	18.2	No	No	No	No						No		Yes	More catch basins.
Eppinger, Julia	3635 N. 56th Drive	85031	247-2544	39	Yes	No	No	No						Yes	Yes	Yes	
Mickle, William C.	4726 W. Crittenden	85031	247-6939	38.2	Yes	No	Yes	No				1975	1957-78	No	Yes	Yes	No flooding since 1978. Resent req'd to pay insurance
Congrove, John	2719 E. Bighorn Avenue	85048	759-7116														See questionnaire for comments.
Maloney, James	5001 W. Crittenden Lane	85031	247-8025	23.9	Yes	No	No	No						No	Yes	Yes	Street floods when drains plugged.
Ben C.	4801 W. Crittenden		247-6927	17.4	No	No	No	No							No		
Ritchie, Rachel	5717 W. Clarendon Avenue		247-2712	37	Yes	No	Yes	No					1958-recent	No	No		
Buck, Leo N.	3441 N. 49th Drive	85031	247-8117	31	Yes	No	No	No						No	No	Yes	
Simonson, Ione J.	3821 N. 57th Avenue	85031	247-8522	39	Yes			No						No	Yes	Yes	
Botrus, Thomas	6136 W. Indianola	85033		30.6	Yes	Yes		No				1966/67		No	Yes	No	
Carrothers, William	6128 W. Indianola	85033	848-6132	2.6	No	No	No	No						No	No	Yes	
Mills, Rita M.	3834 N. 62nd Drive	85033	846-5920	9.3	No												
Vonprisk, Imma	6202 W. Clarendon	85033	846--4100	30	Yes	Yes	Yes	No						No	No	Yes	No problems since drains were installed.
Sandoval, Lillian	4547 W. Mitchell	85031	278-3011	40.2	Yes	No	Yes	Yes	2	4-6in	600	1992	1960	No	No	Yes	Drainage Improvement
Peck, Kenneth	5829 W. Fairmont	85031	247-3606	11.4	Yes		Yes	Yes	1	2in	3,500	1993	1984	No	No	Yes	
Perez, Jose	4554 W. Mitchell Drive	85031	278-8105	25	Yes	Yes	Yes	No						No	Yes		
Hough, Charles	4535 W. Crittenden Lane	85031	272-3076	32.6	Yes	No	Yes	Yes	5	1-5in	20,000	1991		Yes	Yes		
Sprecken, V. Von	3626 N. 56th Dr	85031	247-3713	6	Yes			Yes	1					Yes		Yes	
Doung Van Tran	3820 N. 56th Dr	85031		3	No										Yes		
Harding,Marilyn	5737 W. Indianolo		247-7482	23.2	No	No	No	No							Yes	Yes	
Stroud, Steve/Audrey	6411 W. Sunset Dr	85033	846-9757	10.9	Yes			Yes	1	18-24in	12,000	1992	63	Yes	Yes		
Pool, William G.	4440 W. Mitchell Dr	85031	278-4113	39.6	Yes	No	Yes	No				1992	60, 70,72	No	No		Need 47th Ave S.D. Main w/ diversion for Grand Canal
Diane	6533 W. Sunset Dr	85033	846-2246	20	Yes	Yes	Yes	Yes	2			19,921,993	1980s	Yes	Yes		See questionnaire
Findley, Georgia N.	6327 N. Sunset Dr.	85033	846-2246	30.2	Yes	No	No	Yes				1992		Yes	Yes	Yes	Water comes from 63rd Ave
Reicht, Fran	3438 N. 49th Lane	85031	247-6483	9	Yes	Yes		No				1995	1963	No	No	Yes	
				16.3	No	No	No	No						No	No		

Felicia Terry
Project Manager

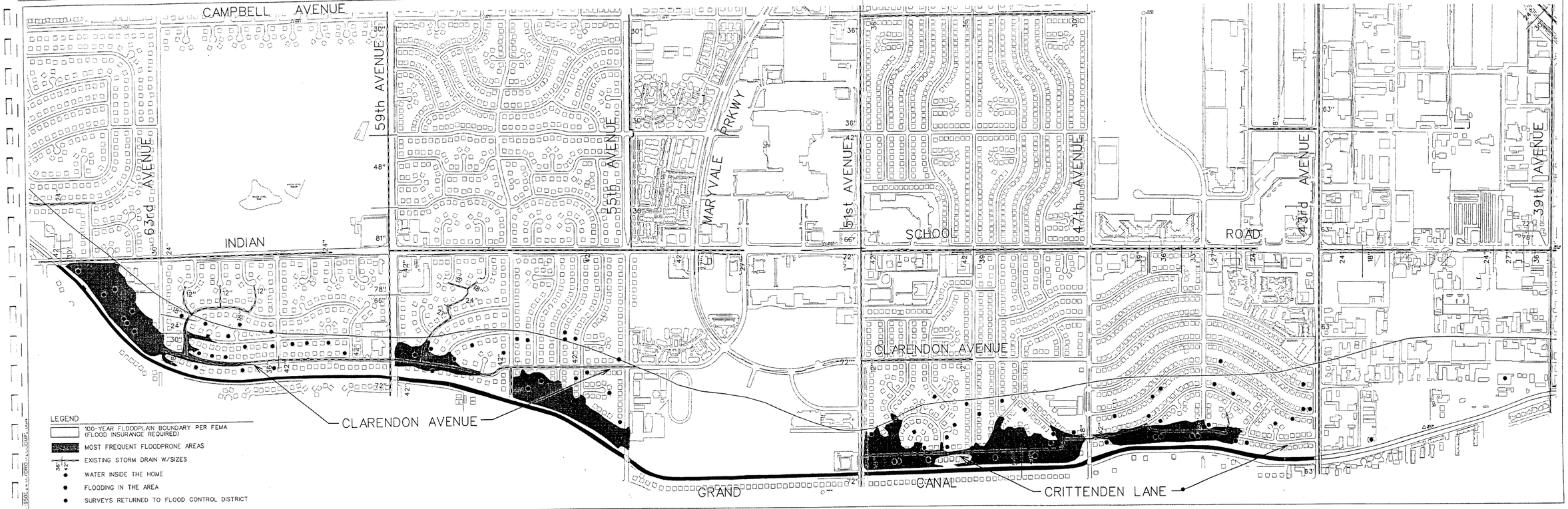
Maryvale Flooding Mitigation Project Survey

Schultz, Elizabeth	4934 W. Crittenden Ln		245-1439	33.1	Yes	Yes		No					1963	Yes	No		Keep drains cleaned out.
Ireland, Adam	4432 W. Crittenden	85031	272-2468	30	Yes	Yes	Yes	Yes	6	18		1993/94		Yes	No	Yes	See questionnaire.
Delley, Audrey	6102 W. Indianola		846-4109	34.6				No	0	0	0	1960s		No	No	Yes	Keep drains cleaned out.
Langford, Don. C.	5838 W. Fairmont	85031	247-1473	29.8	Yes	Yes	Yes	Yes	5	2-24in	50,000	1968		No	Yes	Yes	SRP to control level in the canals during heavy rains.
Anderson, Jim	6223 W. Clarendon		846-1377	10.8	Yes	Yes		No				1993		No	Yes		Mandatory flood insurance.
Downs, Richards	5502 W. Clarendon Ave	85031	247-7914	6	No	No	No	No						No	No	Yes	
Yeary, Steve	3501 N. 42nd Ave	85019	278-7442	20	Yes	No	Yes	Yes	3	24"	25,000	1992	19,841,990	Yes	No		
Dligan, Betty	6123 w. Indianola	85032		11.7	No	No	No	No						No	Yes		
Boswell, Ron	6417 W. Indian School	85033	846-7708	13	Yes	No	No	Yes	0	0	0	1992		No	No	Yes	
Cheryl A. M	3825 N.56th Ave	85031	247-7545	15	No									No	Yes	Yes	See questionnaire
Kerri	3458 N. 49th Ave	85031	247-2200	21	No									No	No	Yes	No problems.
Predovich, Tom	4918 W. Crittenden	85031	247-9083	9	No	No	No	No	0					No	Yes	Yes	
Motz, Anna K.	4332 W. Crittenden	85031	278-4436	40	Yes	No	No	No	0					No	No	No	
Costella, Joan	4405 W. Crittenden	85031	269-2807	20	Yes	No	No	Yes	2	4-6in	1500			Yes	Yes	Yes	
				18	No	No	No	No							Yes		
				5	Yes	Yes	No	No						No	Yes		
Berst, Frances	4302 Whitton			24	No	No	No	No									
Armstrong, Connie	4315 W. Whitton	85031	269-9151	10.6	Yes	No	No	No						Yes	Yes	Yes	More drainage would be nice.
Blair, Ted & Opal	6319 W. Sunset		846-6219	20	Yes	Yes	Yes		2	6in	8,000		1992	Yes	Yes		
Allen, Charles	4351 W. Crittenden	85031	272-0714	24	yes	yes	yes	yes	4	1ft	4,500	1994	1971,83,89	yes	no	yes	
				5	no	no	no	no						no	yes		
Collins, William	P. O. box 7127	33431	407-395-6	9	no			no							no	yes	
Della-Calce, Mike	4721 W. Mitchell	85031	245-1585	38	yes	no	yes	no						no	yes	yes	
Melton, Martha	3616 N. 49th Dr	85031	247-0693	17	no	no	no	no						no	no	yes	Drinking water smells/taste bad
Soto, Mary	6414 W. Sunset	85033		7	yes	yes		yes	1	3ft	3,000	1993		yes	yes	yes	
Hranek, Stephen G.	3451 N. 49th Ave	85031	245-2184	4	no	no	no	no						no	yes	yes	See comments.
Daugherty, Sylvia	4424 W. Mitchell	85031	278-1763	38	yes	yes	yes	no						yes	no		
Munoz, Maria	6332 W. Sunset	85033	846-1777	6.6	yes	yes	yes	yes	2	3ft	400	1992	1991-92	no	yes	yes	
Sotelo, David	4401 W. Weldon	85031	352-1424	2.4	no	no	no	no						no	no	yes	
Haro, Juan	6218 W. Indianola	85033	846-3515	16.3	no	no	no	no					1979-80	no	yes	yes	
Stone, Eugene	4521 Crittenden	85031	278-7468	2.1	no	no	no							no	yes	yes	
Doolin, John	4308 W. Weldon	85031	278-5060	32	yes	no	yes	no				1964		no	no	yes	
Shumway, Van L.	6145 W. Avalon	85033	247-3480	30	no			no						no	no		
Glander, Elmer	6212 W. Clarendon	85033	846-1060	28	yes	yes	ye	no						no	yes	yes	
Kelso, John W.	4714 W. Mitchell	85031	247-8197	35	yes	no	yes	no						no	no	yes	
Jordon, Brian	4308 W. Whitton	85031	278-7699	29	yes	yes	yes	no						yes	yes	yes	
Hvasey, George	4700 W. Thomas		278-7515	38	yes	no	no	yes	3	3ft		1960		no	no	yes	
Rascon, Mary	5534 W. Calrendon	85031	247-7115	2.4	No	no	no	no									Since we have been living here
Ream, Jona L.	4501 W. Crittenden Ln	85031	415-9594	11.5	yes	no		yes	2	2.5"	7,500	Jul-92	1984-92	yes	yes	yes	Buyout & a major flood acquiduct is necessary.
Berst, Frances	4302 Whitton	85031		24	no	no	no	no									

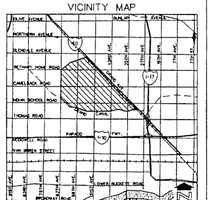
Felicia Terry
Project Manager

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
FLOOD DELINEATION STUDY OF
MARYVALE
FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

FLOODPRONE AREA MAP



VICINITY MAP



300 0' 300 600
SCALE IN FEET
CONTOUR INTERVAL - 1' FEET

DISCLAIMER:
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PRELIMINARY
NOT FOR
CONSTRUCTION
OR RECORDING

CVL
COE & VAN LOO
CONSULTANTS, INC.

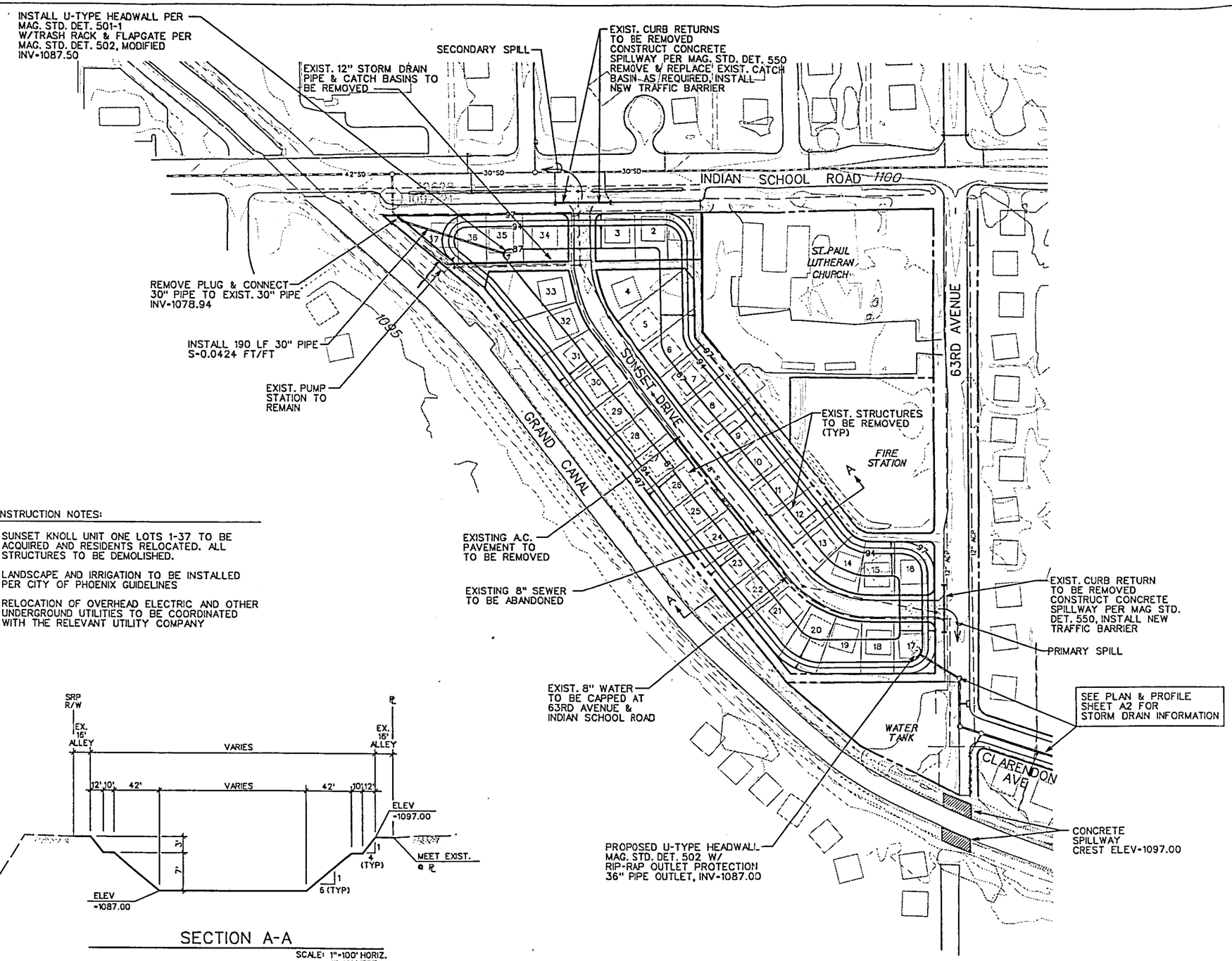
DESIGN:	PWRM/JKM	DATE	FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
DESIGN CHK:	PWRM/JKM		RECOMMENDED BY:
PLANS:	PJE		DATE
PLANS CHK:	PWRM/JKM		APPROVED BY: DATE
SUBMITTED BY:	DATE:		CHIEF ENGINEER AND SECRETARY, MANAGER
			SHEET OF

APPENDIX V
PRELIMINARY PLANS

MARYVALE FLOODING MITIGATION PROJECT
PRELIMINARY DESIGN A

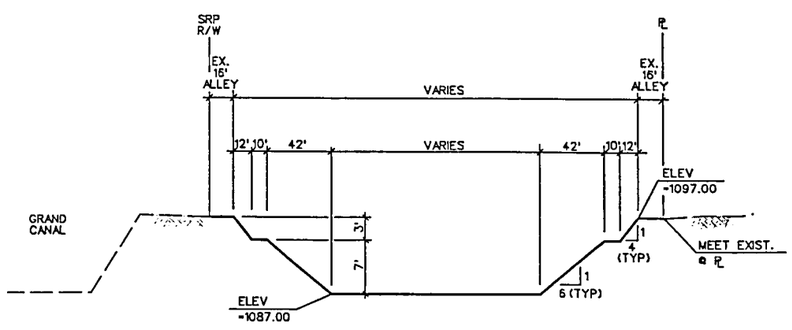
Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1		Basin Excavation	42,800	CY	3.00	$128,400
		30" RGRCP	190	LF	75.00	$14,250
		U-Type Hdwl w/Flapgate (30")	1	EA	3,000.00	$3,000
		4 Concrete Spillways	150	CY	250.00	$37,500
		U-Type Hdwl (36")	1	EA	2,500.00	$2,500
		Riprap, D50=12", Thickness=2'	120	CY	45.00	$5,400
		Demolish Existing Homes	36	EA	5,000.00	$180,000
		36" RGRCP	500	LF	90.00	$45,000
		Manhole	2	EA	2,000.00	$4,000
		Remove Exist. Manhole & S.D.	1	LS	500.00	$500
		Ctach Basin	5	EA	1,800.00	$9,000
		Landscape Restoration	1	LS	1,060,000.00	$1,060,000
		Miscellaneous Utility Relocations	1	LS	10,000.00	$10,000
		Subtotal				$1,499,550
		Engineering & Contingencies @ 20%				$299,910
		Land Acquisition				$1,775,000
		Surveying & Other Acquisition Costs @ 20%				$355,000
		TOTAL PROJECT BUDGET				**$3,929,460**

Note: These cost estimates have been developed as a part of the Pre-Design Report submittal. Estimates are provided for the purposes of comparison only and are not intended to reflect an engineering estimate of the final construction cost. All costs are based upon a 1995 datum.



CONSTRUCTION NOTES:

1. SUNSET KNOLL UNIT ONE LOTS 1-37 TO BE ACQUIRED AND RESIDENTS RELOCATED. ALL STRUCTURES TO BE DEMOLISHED.
2. LANDSCAPE AND IRRIGATION TO BE INSTALLED PER CITY OF PHOENIX GUIDELINES
3. RELOCATION OF OVERHEAD ELECTRIC AND OTHER UNDERGROUND UTILITIES TO BE COORDINATED WITH THE RELEVANT UTILITY COMPANY



SECTION A-A

SCALE: 1"=100' HORIZ. 1"=10' VERT.

SUNSET DRIVE DETENTION BASIN

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PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

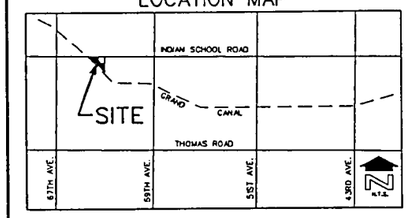
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF MARYVALE FLOODING MITIGATION PROJECT

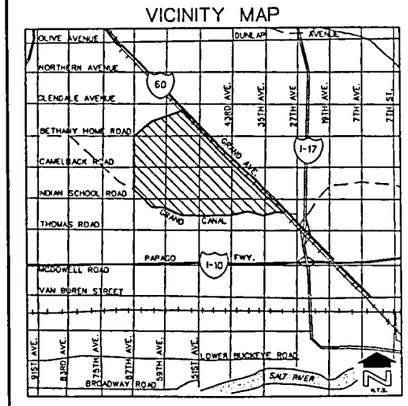
F.C.D. CONTRACT NO. 93-94

AREA 'A' PRELIMINARY DESIGN PLANS

LOCATION MAP



VICINITY MAP



100 0' 100 200

SCALE IN FEET

CONTOUR INTERVAL - 1' FEET

COE & VAN LOO, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

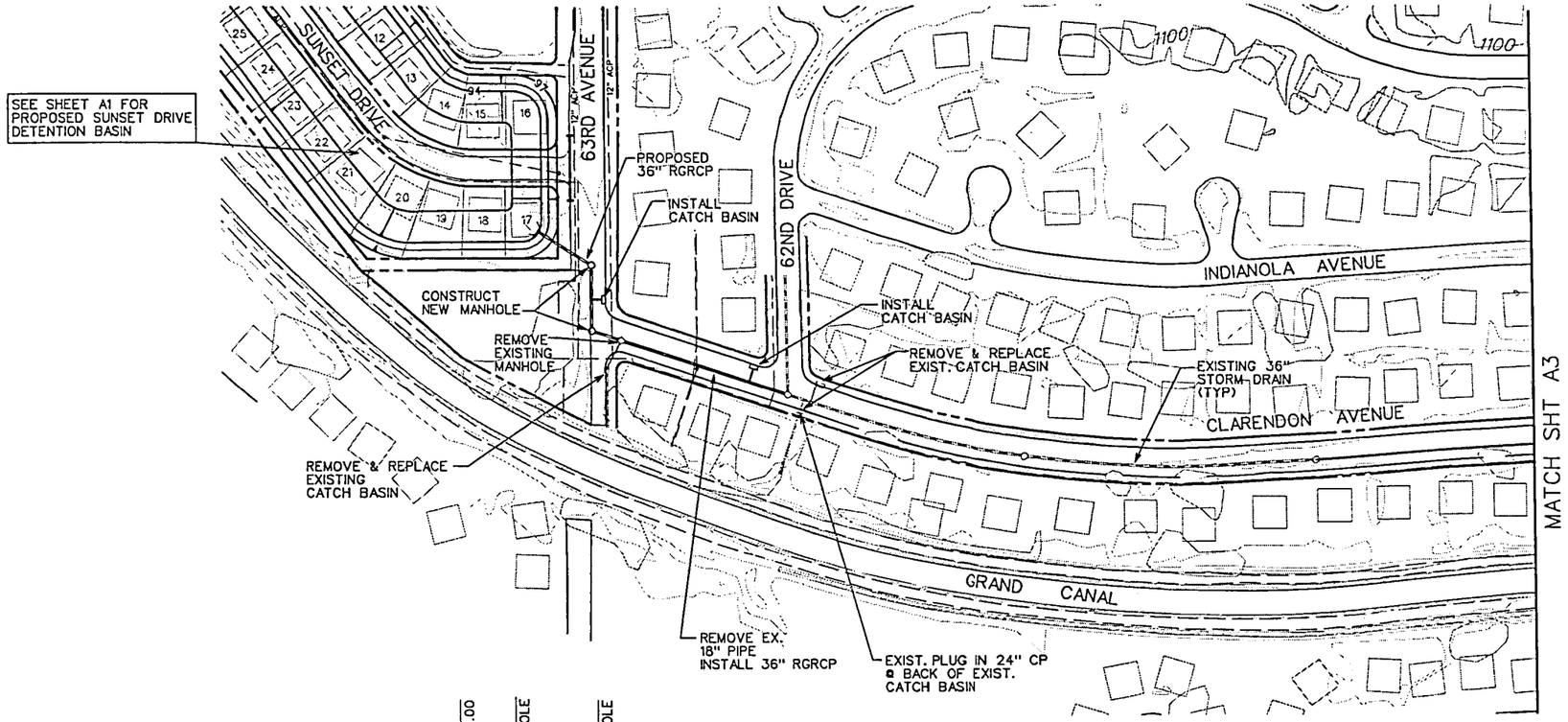
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

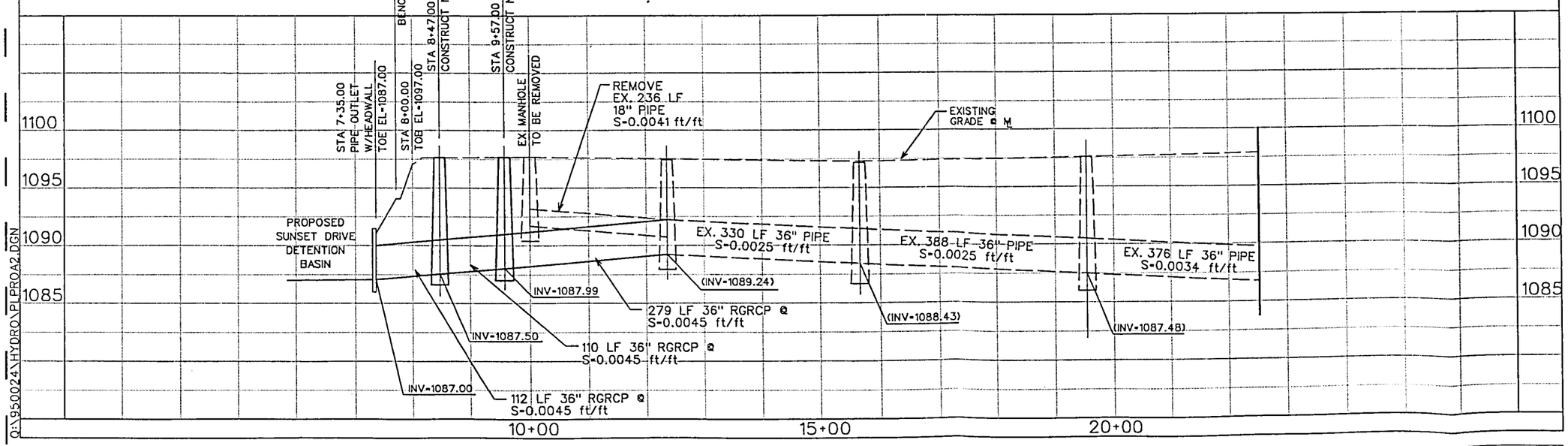
APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

SHEET A1 OF A3



CLARENDON AVENUE STORM DRAIN



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PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

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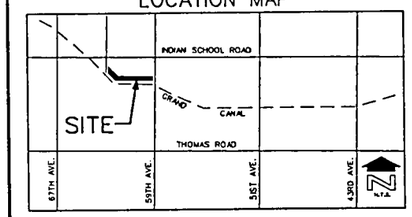
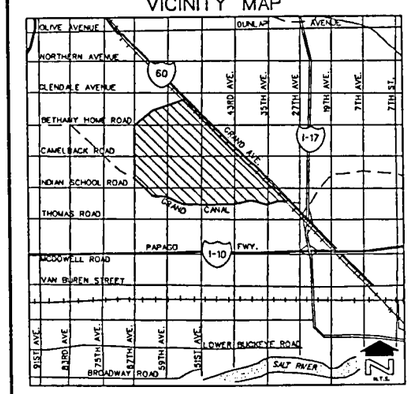
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FLOOD DELINEATION STUDY OF MARYVALE FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

AREA 'A' PRELIMINARY DESIGN PLANS

LOCATION MAP



VICINITY MAP

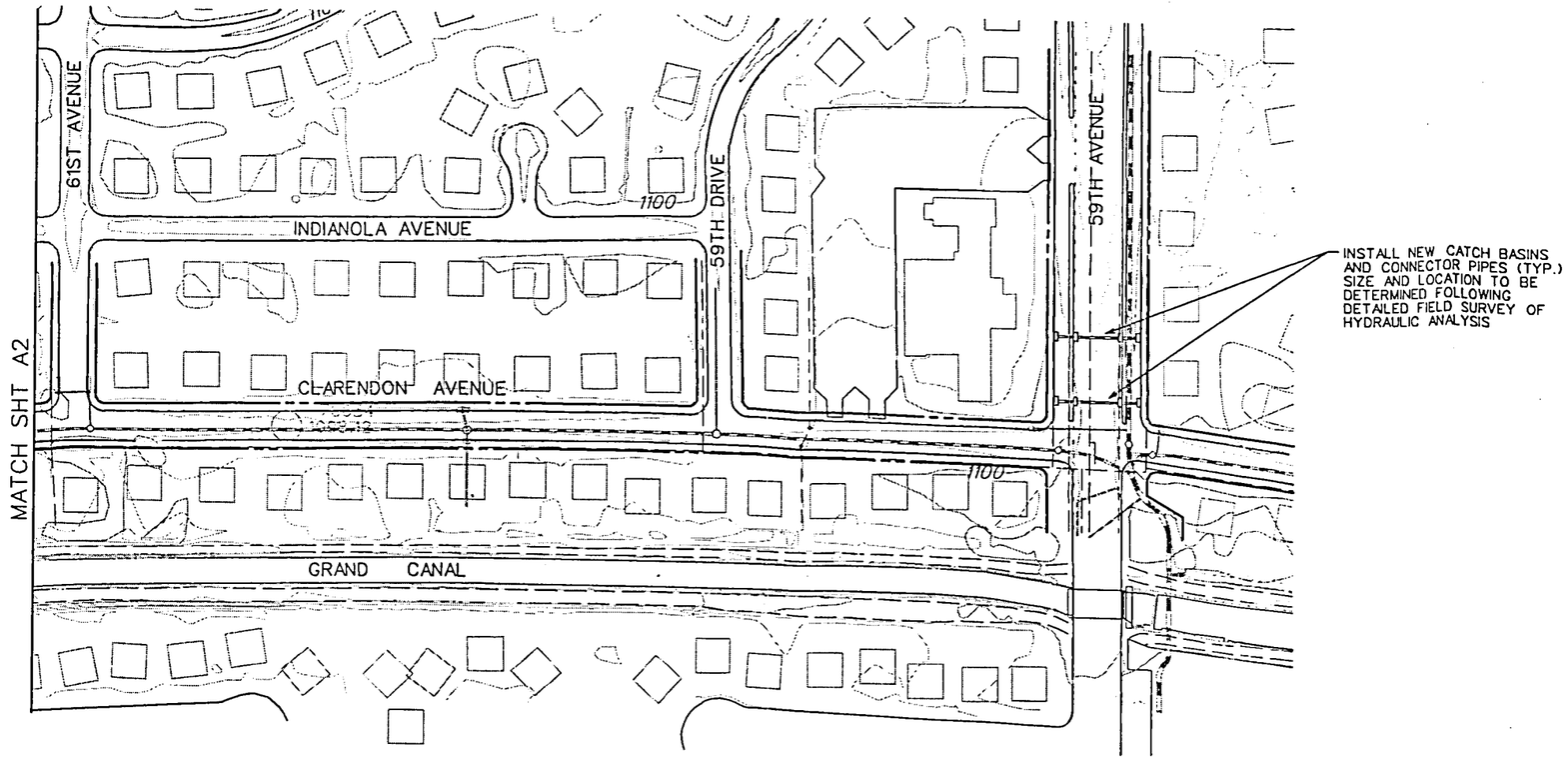


100 0' 100 200
SCALE IN FEET
CONTOUR INTERVAL - 1' FEET

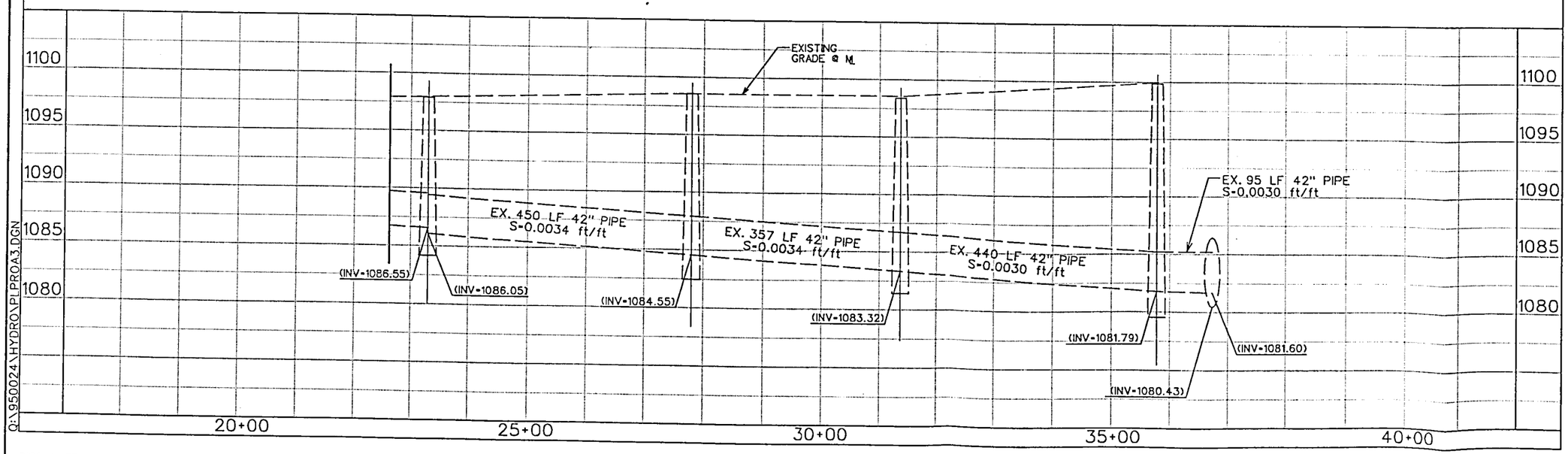
COE & VAN LOO, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJC	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
RECOMMENDED BY: DATE
APPROVED BY: DATE
CHIEF ENGINEER AND GENERAL MANAGER
SHEET A2 OF A3



CLARENDON AVENUE STORM DRAIN



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PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

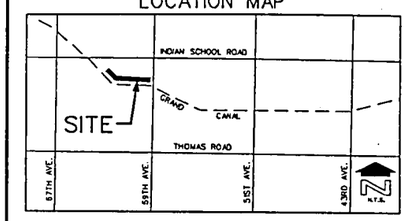
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF MARYVALE FLOODING MITIGATION PROJECT

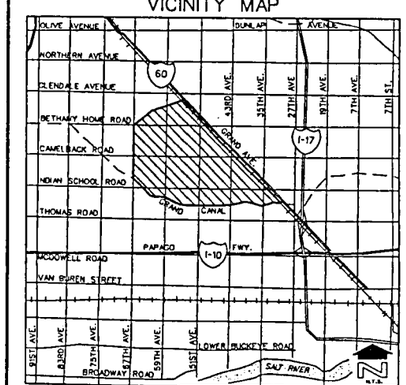
F.C.D. CONTRACT NO. 93-94

AREA 'A' PRELIMINARY DESIGN PLANS

LOCATION MAP



VICINITY MAP



100 0' 100 200
SCALE IN FEET
CONTOUR INTERVAL - 1' FEET

COE & VAN LOO, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		
	DATE:	

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

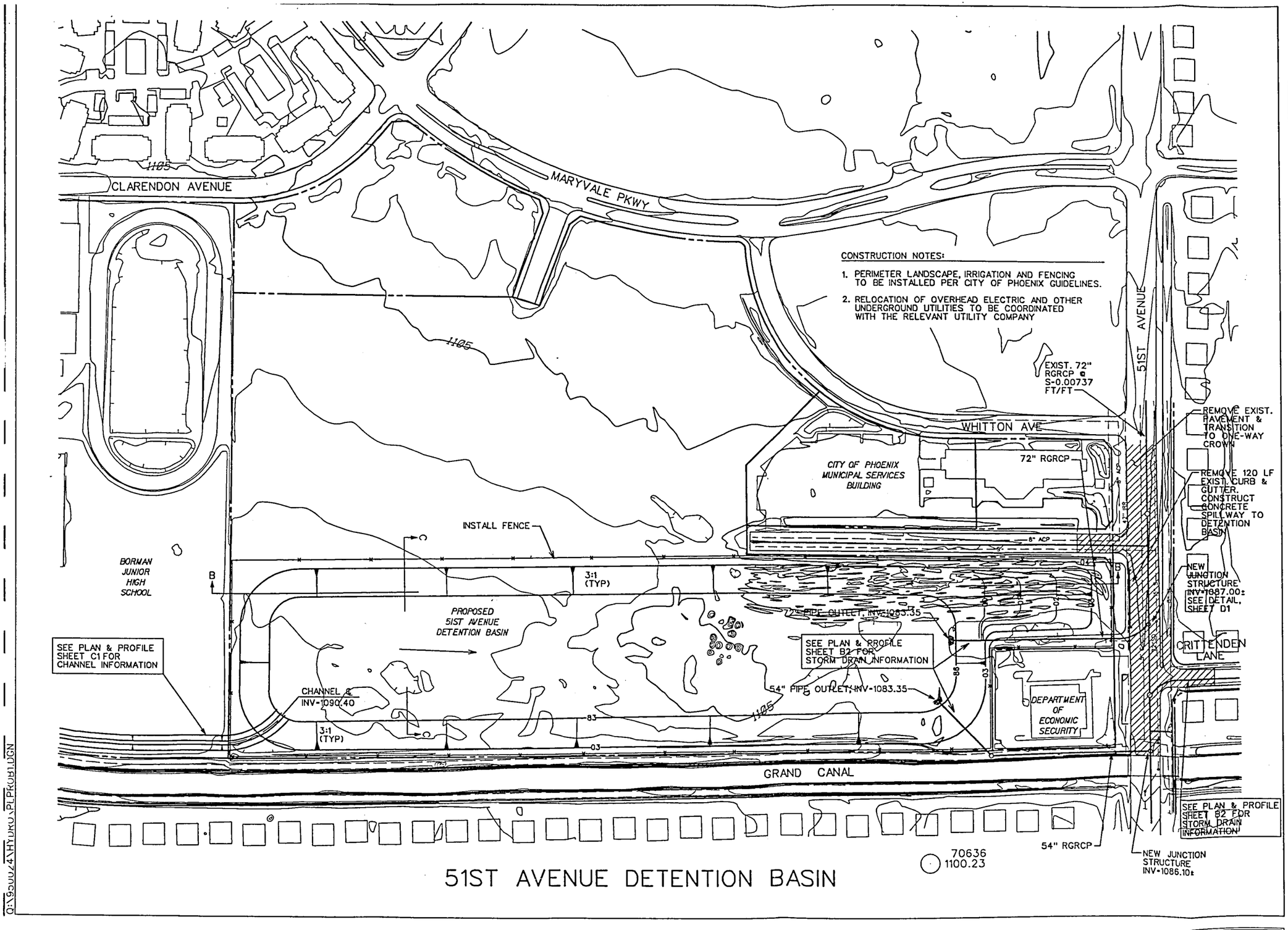
CHIEF ENGINEER AND GENERAL MANAGER

SHEET A3 OF A3

MARYVALE FLOODING MITIGATION PROJECT
PRELIMINARY DESIGN B

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1		Basin Excavation	484,000	CY	3.00	$1,452,000
		Perimeter Fencing & Screening	4,970	LF	26.00	$129,220
		Concrete Spillway	110	CY	250.00	$27,500
		Remove & Replace Exist. Pavement	44,000	SF	5.00	$220,000
		Junction Structure	2	EA	6,000.00	$12,000
		Riprap, D50=12", Thickness=2'	240	CY	45.00	$10,800
		72" RGRCP	430	LF	175.00	$75,250
		54" RGRCP	370	LF	125.00	$46,250
		U-Type Hdwl (54"0	1	EA	3,000.00	$3,000
		Straight Headwall (72")	1	LS	3,000.00	$3,000
		Catch Basin	29	EA	1,800.00	$52,200
		Traffic Control	1	LS	30,000.00	$30,000
		Miscellaneous Utility Relocations	1	LS	10,000.00	$10,000
		Subtotal				$2,071,220
		Engineering & Contingencies @ 20%				$414,244
		Land Acquisition				$2,200,000
		Surveying & Other Acquisition Costs @ 20%				$440,000
		TOTAL PROJECT BUDGET				**$5,125,464**

Note: These cost estimates have been developed as a part of the Pre-Design Report submittal. Estimates are provided for the purposes of comparison only and are not intended to reflect an engineering estimate of the final construction cost. All costs are based upon a 1995 datum.



51ST AVENUE DETENTION BASIN

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DISCLAIMER:
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PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

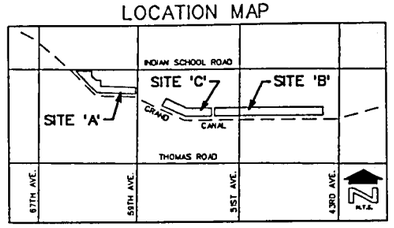
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF MARYVALE FLOODING MITIGATION PROJECT

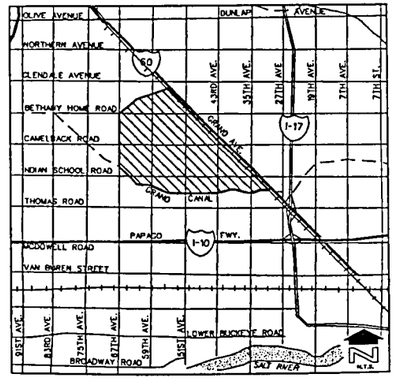
F.C.D. CONTRACT NO. 93-94

AREA 'B' PRELIMINARY DESIGN PLANS

LOCATION MAP



VICINITY MAP



100 0' 100 200
SCALE IN FEET
CONTOUR INTERVAL - 1' FEET

COE & VAN LOO CONSULTANTS, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

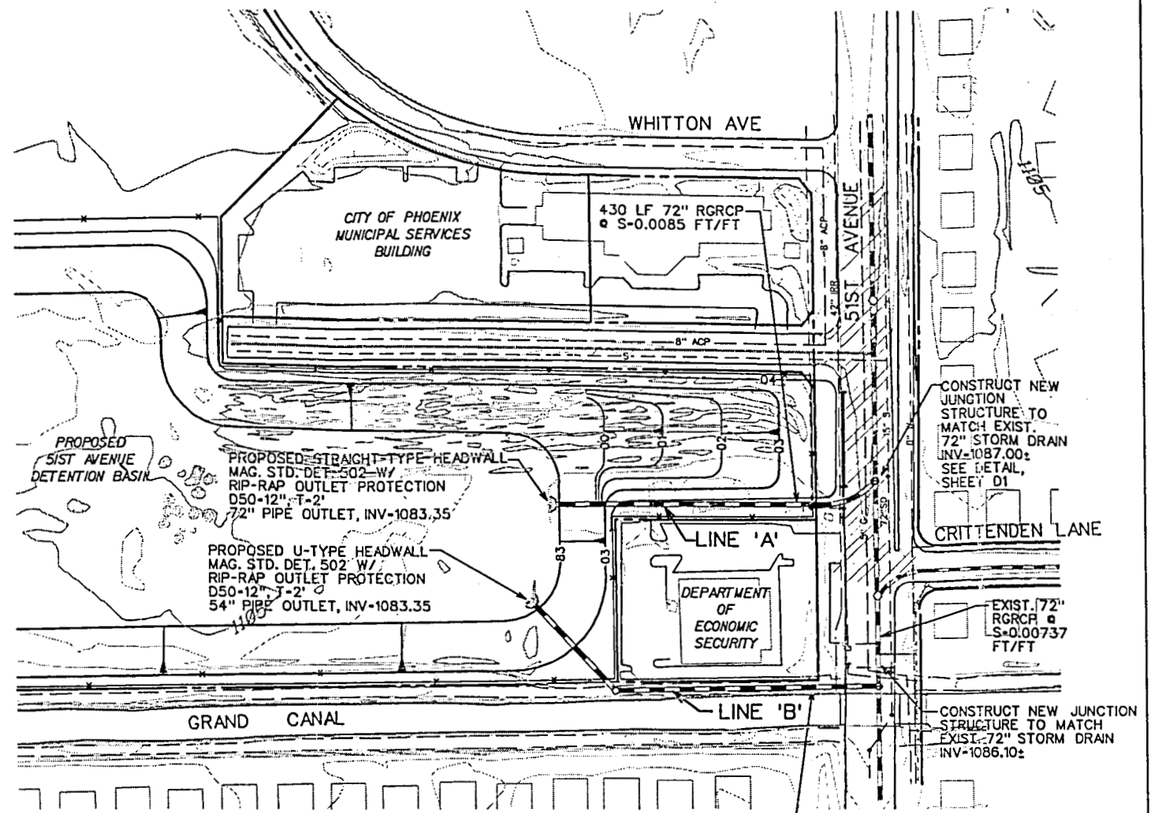
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

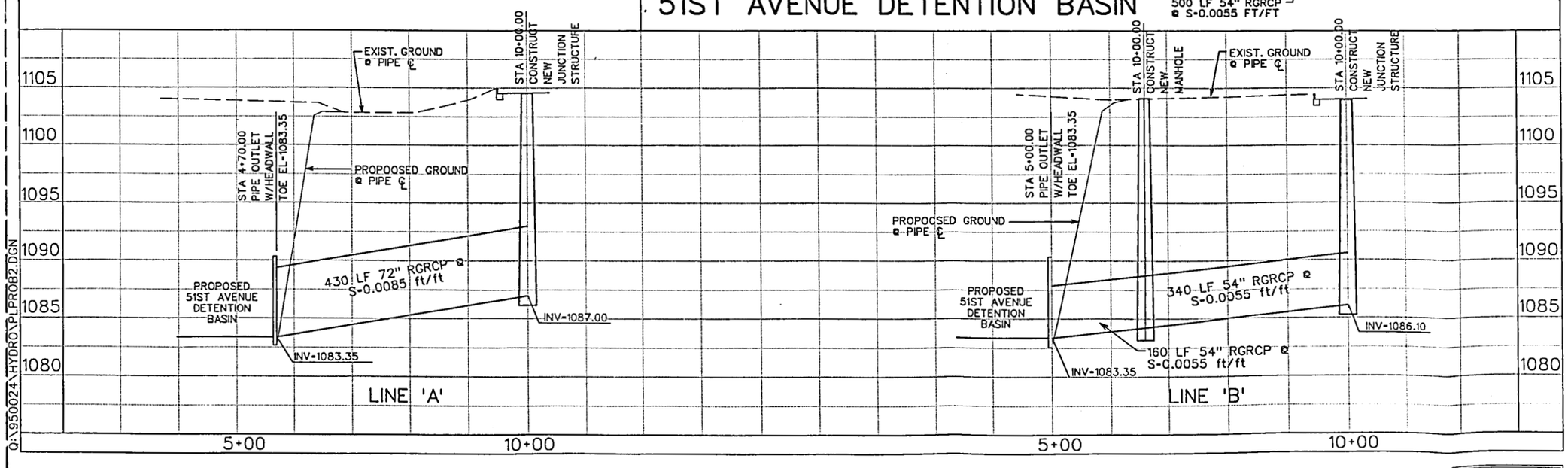
APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

SHEET B1 OF B4



51ST AVENUE DETENTION BASIN



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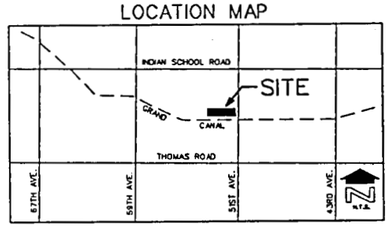
PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

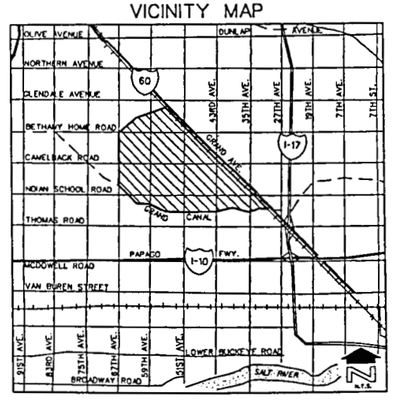
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FLOOD DELINEATION STUDY OF MARYVALE FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

AREA 'B' PRELIMINARY DESIGN PLANS

LOCATION MAP



VICINITY MAP



100 0' 100 200
SCALE IN FEET
CONTOUR INTERVAL - 1' FEET

COE & VAN LOO, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
RECOMMENDED BY: DATE
APPROVED BY: DATE
CHIEF ENGINEER AND GENERAL MANAGER
SHEET B2 OF B4

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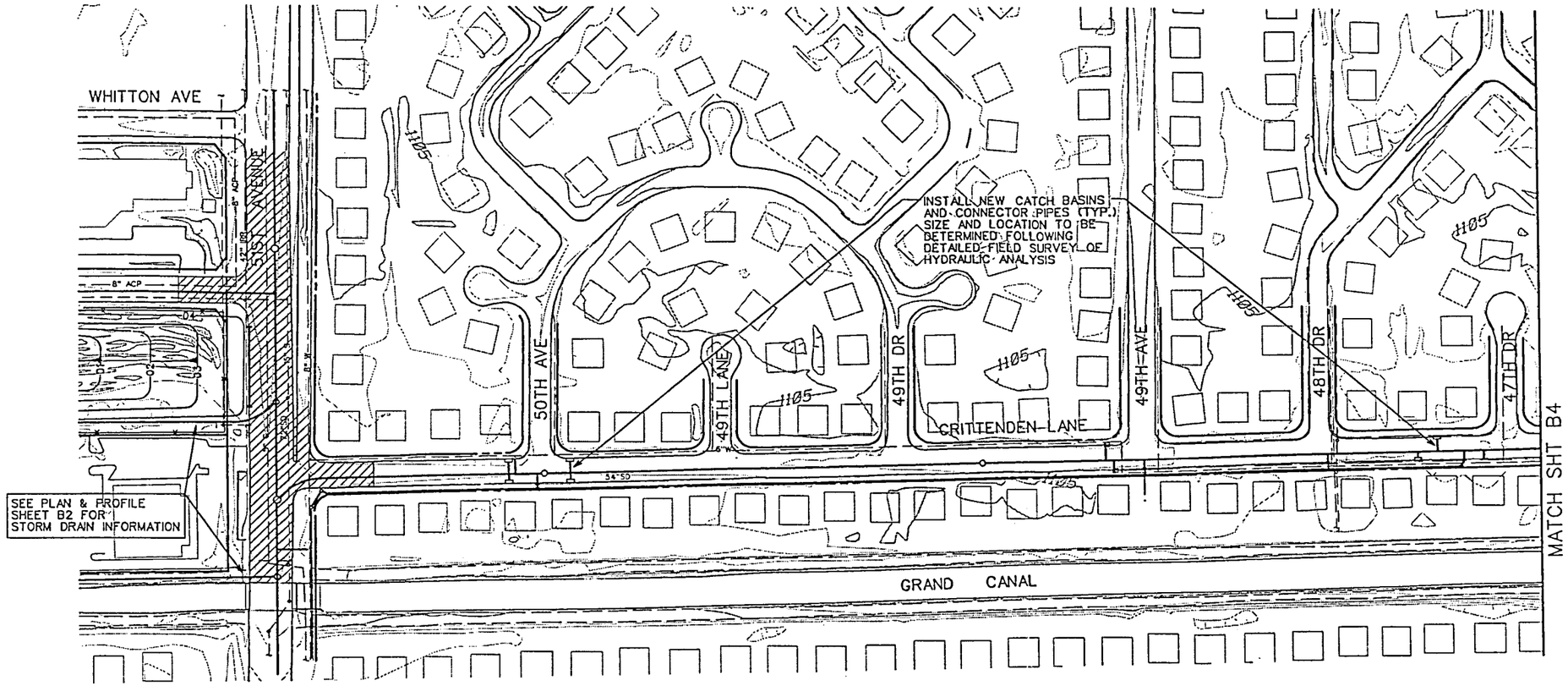
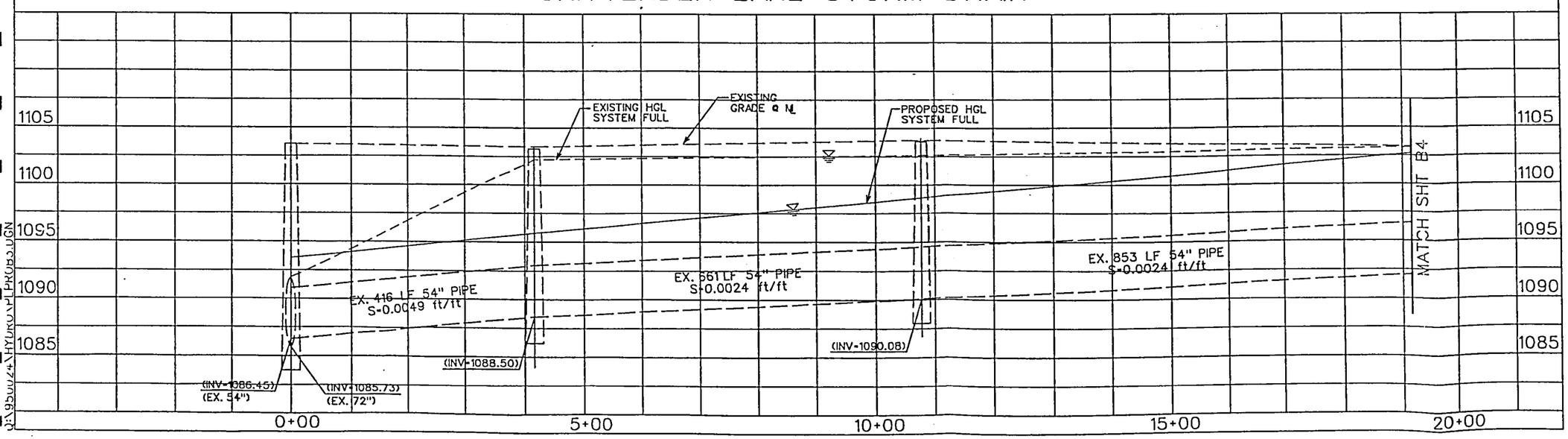


CRITTENDEN LANE STORM DRAIN



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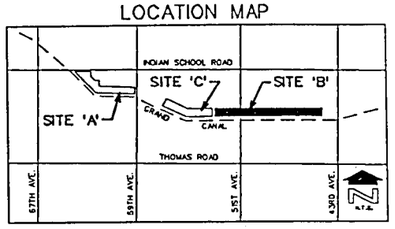
PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

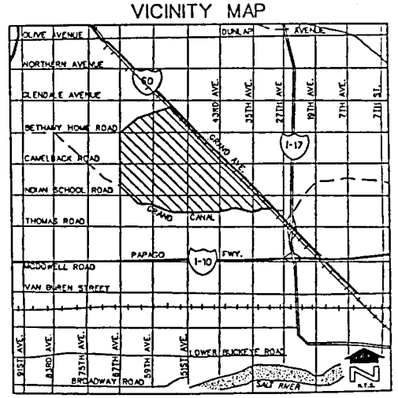
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FLOOD DELINEATION STUDY OF MARYVALE FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

AREA 'B' PRELIMINARY DESIGN PLANS

LOCATION MAP



VICINITY MAP

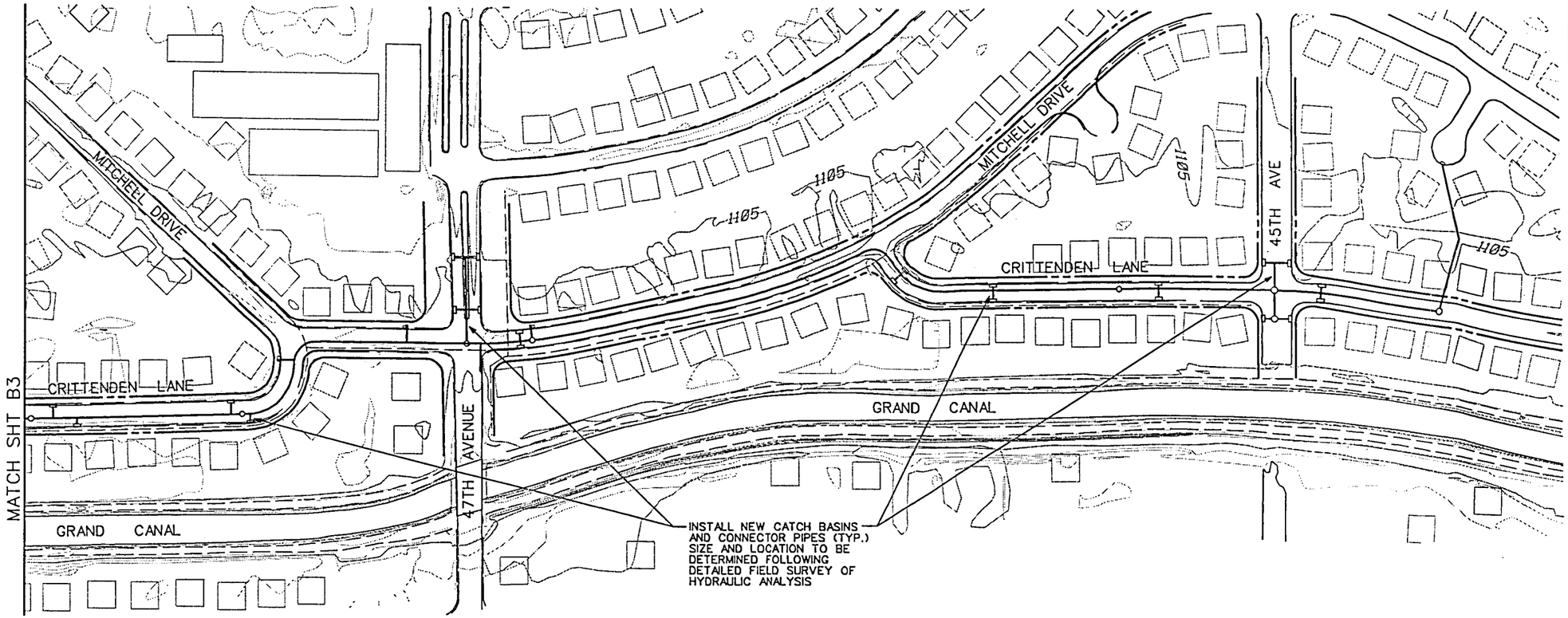


100 0' 100 200
SCALE IN FEET
CONTOUR INTERVAL - 1' FEET

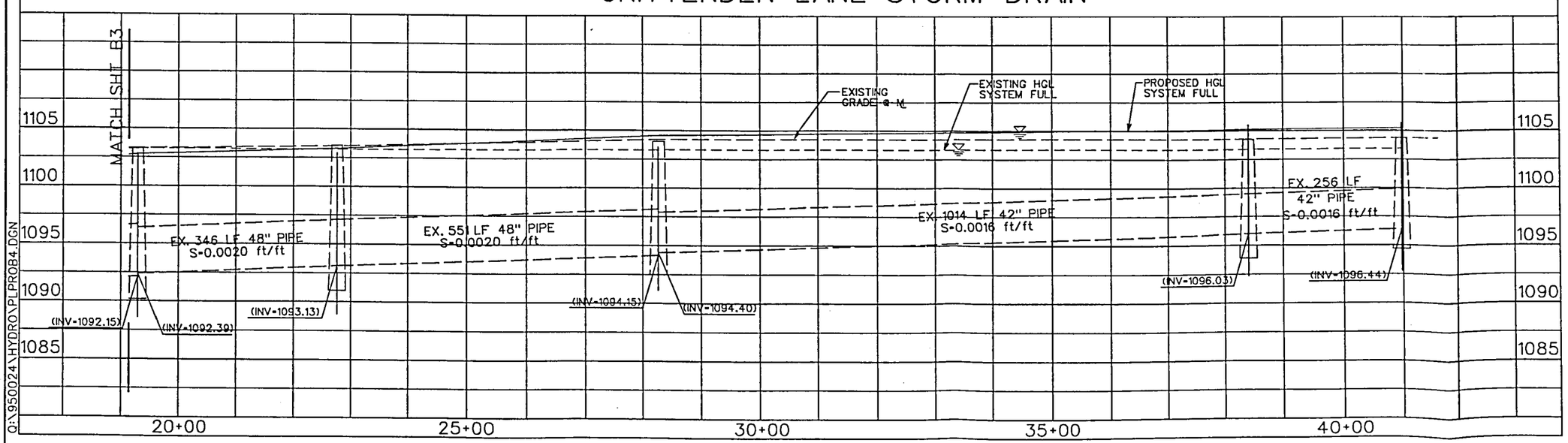
CYL COE & VAN LOO CONSULTANTS, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
RECOMMENDED BY: DATE
APPROVED BY: DATE
CHIEF ENGINEER AND GENERAL MANAGER
SHEET B3 OF B4



CRITTENDEN LANE STORM DRAIN



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PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

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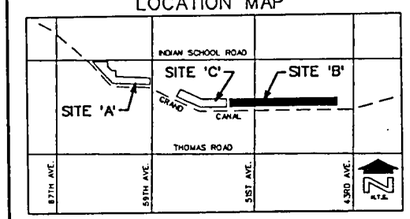
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF MARYVALE FLOODING MITIGATION PROJECT

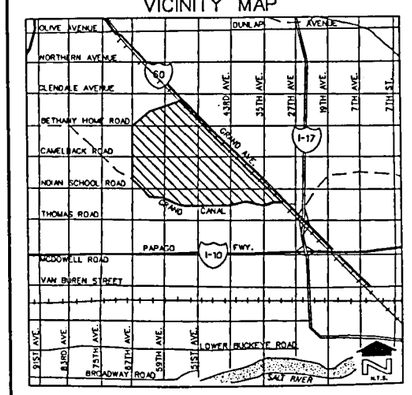
F.C.D. CONTRACT NO. 93-94

AREA 'B' PRELIMINARY DESIGN PLANS

LOCATION MAP



VICINITY MAP



100 0' 100 200
SCALE IN FEET
CONTOUR INTERVAL = 1' FEET

CVL COE & VAN LOO CONSULTANTS, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

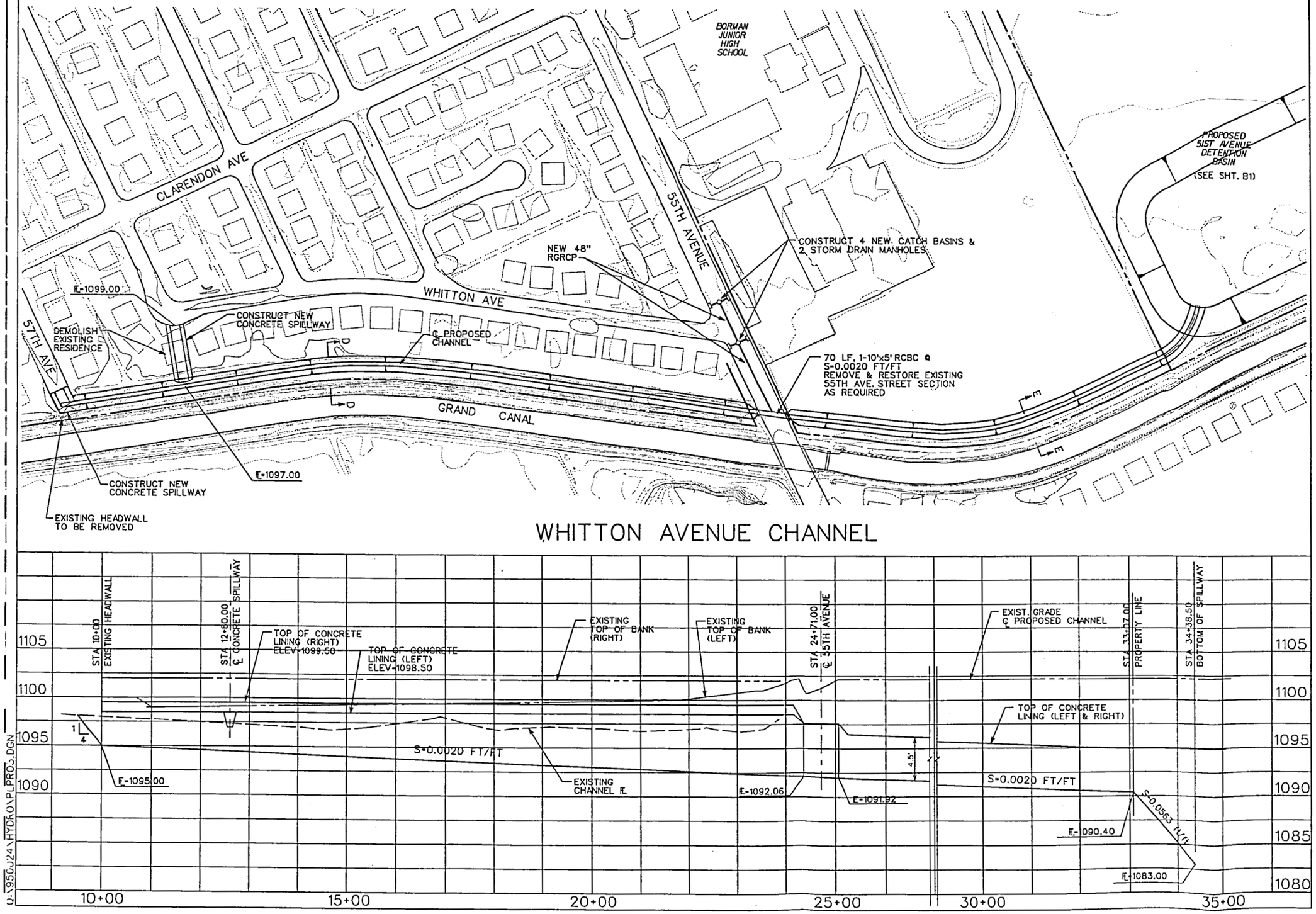
CHIEF ENGINEER AND GENERAL MANAGER

SHEET B4 OF B4

MARYVALE FLOODING MITIGATION PROJECT
PRELIMINARY DESIGN C

Item No.	Capacity	Facilities Description & Location	Quantity	Unit	Unit Cost ($)	Cost ($)
1		Channel Excavation	13,000	CY	3.00	$39,000
		70 LF, 10'x5' RCBC	1	LS	23,000.00	$23,000
		2 Concrete Spillway	110	CY	250.00	$27,500
		48" RGRCP	250	LF	115.00	$28,750
		Catch Basin	4	EA	1,800.00	$7,200
		Riprap, D50=12", Thickness=2'	240	CY	45.00	$10,800
		Traffic Control	1	LS	10,000.00	$10,000
		Miscellaneous Utility Relocations	1	LS	5,000.00	$5,000
		Concrete Channel Lining	1,500	SF	250.00	$375,000
		Subtotal				$526,250
		Engineering & Contingencies @ 20%				$105,250
		Land Acquisition				$100,000
		Surveying & Other Acquisition Costs @ 20%				$20,000
		TOTAL PROJECT BUDGET				**$751,500**

Note: These cost estimates have been developed as a part of the Pre-Design Report submittal. Estimates are provided for the purposes of comparison only and are not intended to reflect an engineering estimate of the final construction cost. All costs are based upon a 1995 datum.



WHITTON AVENUE CHANNEL

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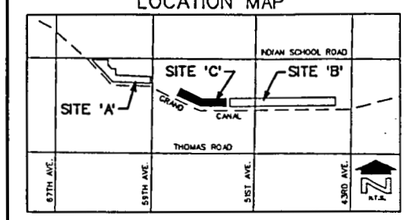
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

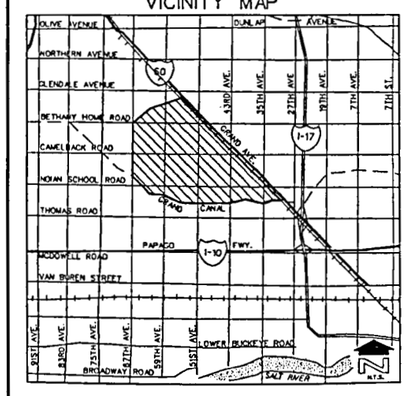
FLOOD DELINEATION STUDY OF
MARYVALE
FLOODING MITIGATION PROJECT
F.C.D. CONTRACT NO. 93-94

AREA 'C' PRELIMINARY DESIGN PLANS

LOCATION MAP



VICINITY MAP



100 0' 100 200
SCALE IN FEET
CONTOUR INTERVAL = 1' FEET

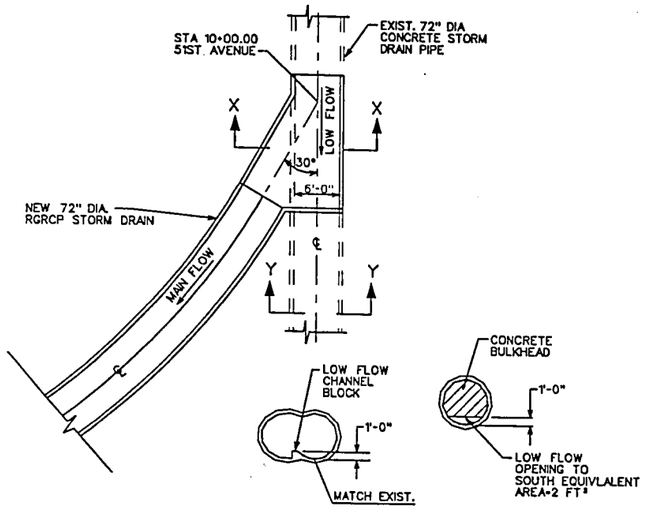
COE & VAN LOO CONSULTANTS, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE
APPROVED BY: DATE
CHIEF ENGINEER AND GENERAL MANAGER

SHEET C1 OF C1

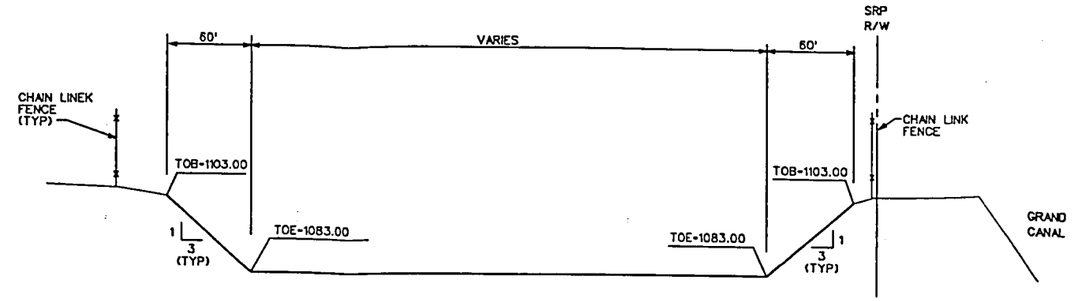


SECTION X-X

SECTION Y-Y

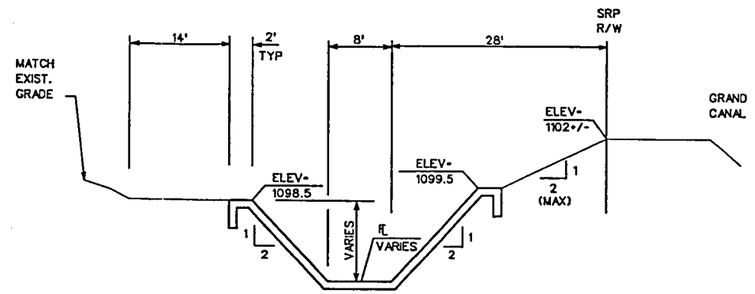
51ST AVENUE JUNCTION STRUCTURE

SEE PLAN & PROFILE SHEET B1 & B2 N.T.S.



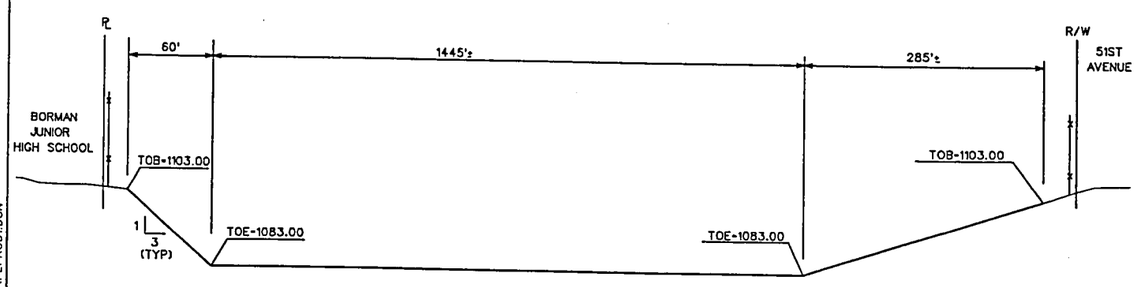
SECTION C-C

SEE PLAN SHEET B1 N.T.S.



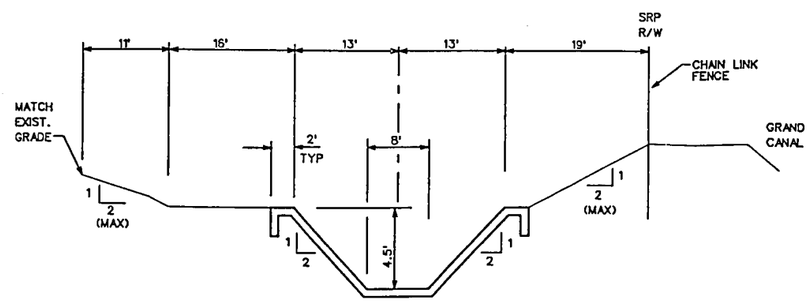
SECTION D-D

SEE PLAN & PROFILE SHEET C1 N.T.S.



SECTION B-B

SEE PLAN SHEET B1 N.T.S.



SECTION E-E

SEE PLAN & PROFILE SHEET C1 N.T.S.

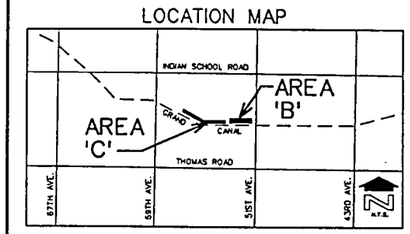
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF MARYVALE FLOODING MITIGATION PROJECT

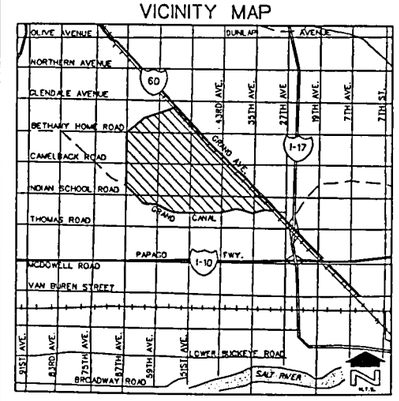
F.C.D. CONTRACT NO. 93-94

AREA 'B' & 'C' PRELIMINARY DESIGN DETAILS

LOCATION MAP



VICINITY MAP



COE & VAN LOO, INC.

	BY	DATE
DESIGN	PWRH/JKM	
DESIGN CHK.	PWRH/JKM	
PLANS	PJE	
PLANS CHK.	PWRH/JKM	
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

SHEET D1 OF D1

PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

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