

Broadway Road / Rural Road Candidate Assessment Report



Prepared for:

Flood Control District of Maricopa County

Prepared by:

Project Engineering Consultants, Ltd.



September 2002

PROJECT ENGINEERING
CONSULTANTS, LTD.



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Executive Summary Rural and Broadway Roads Candidate Assessment Report

Project Purpose

This Candidate Assessment Report (CAR) was prepared to document the existing conditions and available information regarding drainage problems in the area of Rural and Broadway Roads and the Daley Park Neighborhood. The City of Tempe (City) has requested the Flood Control District of Maricopa County (District) to evaluate flooding in this area. The project is generally located between College Ave., McClintock Ave., Alameda Ave., and the Union Pacific Railroad (UPRR).

Summary of Findings

The flooding occurs at the Broadway and Rural intersection and in a residential neighborhood to the north west of the intersection. There are not adequate facilities to convey storm water out of the area. Storm water enters the intersection and eventually the neighborhood from a watershed that was developed prior to the institution of retention requirements. Storm drains convey the storm water until they become surcharged. Irrigation pipelines are interconnected with storm drains but are still not able to convey stormwater. A Salt River Project ditch south of the UPRR is also not adequate to convey all of the stormwater. The City constructed a bypass pipeline and installed two flap gates in the Rural Road storm drain irrigation drainage system to help mitigate flooding in the area. The modifications were complete and in place prior to the July 29, 2001 storm. The storm still caused flooding in the area.

Conclusions

To properly evaluate the drainage problems and solutions for the following three steps are recommended for further investigation:

Step 1 – Hydrologic Study

A key piece of data that is not available for this area is a hydrologic study. A hydrologic model would define the location and the magnitude of the flooding problems. Any development of drainage solutions to the problems in the Daley Park Neighborhood and the flooding of Broadway Road and Rural Road would require that a hydrologic model be developed.

Step 2 – Flood Delineation Map

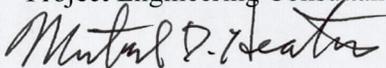
The impact of the study needs to be evaluated. The area of flooding should be delineated and a map created based on the hydrology and possibly a hydraulic model. A damage assessment could be determined based on the value of the impacted properties.

Step 3 – Develop Alternatives

Based on the hydrologic model and the flood area delineation impact map various solutions could be developed. Multiple solutions should be investigated and the optimal solution determined from these alternates.

Submitted by:

Project Engineering Consultants, Ltd.



Michael D. Heaton, PE
Project Manager



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Rural Road Flap Gate and Storm Drain Bypass Plans

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1.0 Purpose and Need

1.1 Project Purpose

This Candidate Assessment Report (CAR) will document the existing conditions and available information regarding drainage problems in the City of Tempe, Maricopa County, Arizona in the area of Rural Road and Broadway Road known as the Daley Park Neighborhood. The City of Tempe (City) has requested participation by the Flood Control District of Maricopa County (District) in providing drainage improvements that will mitigate flooding at this location. In order to assess this CAR the District has contracted with Project Engineering Consultants, Ltd. This report will summarize the existing information identified during this effort relating to land use, existing hydrology/hydraulics reports, existing topographic mapping, as-built plans for existing drainage infrastructure, FEMA flood hazard Boundary Maps, and other information which may be pertinent to the drainage problems.

1.1.1 Project Need

The City has designated homes in the development between Broadway Road and the Union Pacific Railroad (UPRR) on the west side of Rural Road as the Daley Park Neighborhood. Homes on the east end of this neighborhood have experienced flooding during significant rainfall events in the watershed. Homes particularly in the extreme northeast corner of the Daley Park neighborhood have experienced this problem. The City has made efforts to minimize the impact of this flooding, but realizes that a larger solution will be required to solve the problem and satisfy both the City and the residents. The City has replaced flooring in at least one of the homes affected by the flooding.

1.1.2 Project Participation

Agency and municipal participation in this CAR is limited to the District and the City. The City requested the drainage improvements and the District is providing the preliminary feasibility study in this CAR. The Salt River Project (SRP) and the UPRR have also provided information for this study.

1.1.2.1 Interagency Coordination

The City has provided available information for the study area. The watershed is an older area and is mostly developed. The Daley Park Neighborhood was developed in the mid 1950's and data for this development and most others in the watershed is not available. The City's Geographic Information System (GIS) provided much information particularly for the Daley Park Neighborhood. Also, City engineers participated in field trips to the study area and provided their personal knowledge regarding drainage problems in the area.

The District also provided all requested resources that may help the investigation of the flooding in the study area. District engineers have participated in field trips to the study area and provided their personal knowledge regarding drainage problems in the area.

SRP allows for drainage in some of its irrigation pipes in the area. SRP has provided all requested resources that may help with the investigation of the flooding in the study area.

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The UPRR, adjacent to the Daley Park Neighborhood, has provided right-of-way drawings for the railroad as requested to help the investigation of the flooding in the study area.

1.1.2.2 Special Interest Groups

No special interest groups have been involved with the study. However, late in the schedule a web site was located for the Daley Park Neighborhood Association.

1.1.2.3 Public Involvement

The City maintains a web site where connections to neighborhood organizations are linked. The City link to the Daley Park Neighborhood is found at <http://www.tempe.gov/nhoods/photo12.htm>. The Daley Park Neighborhood Association site included a contact page that listed Mr. James Newell as Chairman. An email was sent to Mr. Newell explaining the CAR and the process as well as the support provided by the City and the District. The email requested that if he or any of the members of the association had any further information that may be of assistance to the study, we would like to see or discuss it with them. There has not been a response from Newell at this time.

No public involvement was required for this study. While the City has taken citizen (homeowners) comments, none have been provided to PEC specifically. A video taken by a resident of the neighborhood following the July 29th 2001 storm was provided to PEC. Snapshots taken from the video are provided in Appendix A.

Neighborhoods

Home Site Map Search

Daley Park

192 Households

Built: Early-mid1950's

Boundaries:

- RR Tracks-Broadway
- College-Rural

Schools:

- Broadmor Elementary School
- McKerny Middle School
- Tempe High School

East Solana Drive

Go to the Daley Park web site!

Newspaper Ads:

- December 9, 1955 (24k)
- March 10, 1956 (11k)
- March 17, 1956 (25k)

Next Neighborhood Back to Association List

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2.0 Project Overview and History

2.1 Project Overview

The City has requested a study to examine the repeated flooding within the Daley Park Neighborhood at the northwest corner of Rural and Broadway Roads. The purpose of this CAR is:

- to develop a list of known flooding problems impacting the area,
- to document or establish the need and necessity for any flood control projects,
- to collect all available pertinent data,
- to make recommendations for future studies,
- to document the information collected, and
- to make recommendations to the District for the next step in the process.

2.2 Project Location

The project area is in the City west of Rural Road and south of the UPRR, located in the Southwest Quarter of Section 23, Township 1 North, and Range 4 East of the Salt Gila Baseline and Meridian, Maricopa County, Arizona. The stormwater runoff causing the flooding in the Daley Park Neighborhood is conveyed to the neighborhood from a drainage area located some distance from the neighborhood. Therefore, the potential drainage area that contributes this location is also included in the study area. The southern boundary of this potential drainage area is near Alameda Road along an SRP underground pipeline. The northern boundary is clearly the raised UPRR embankment. The eastern boundary is McClintock Road. Rural Road and alley west of Ventura Drive make up the western boundary. Figure 1 is an Area Map showing the location of the study area. Figure 2 is an aerial map showing the potential drainage area for the Daley Park Neighborhood. Figure 3 is the USGS Map for the area (Photo revised 1982).

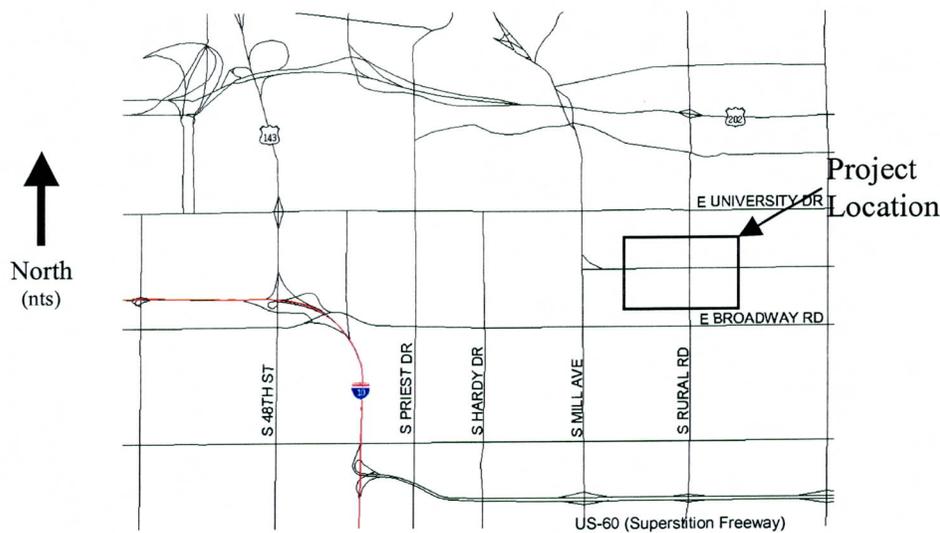


Figure 1 - Location Map

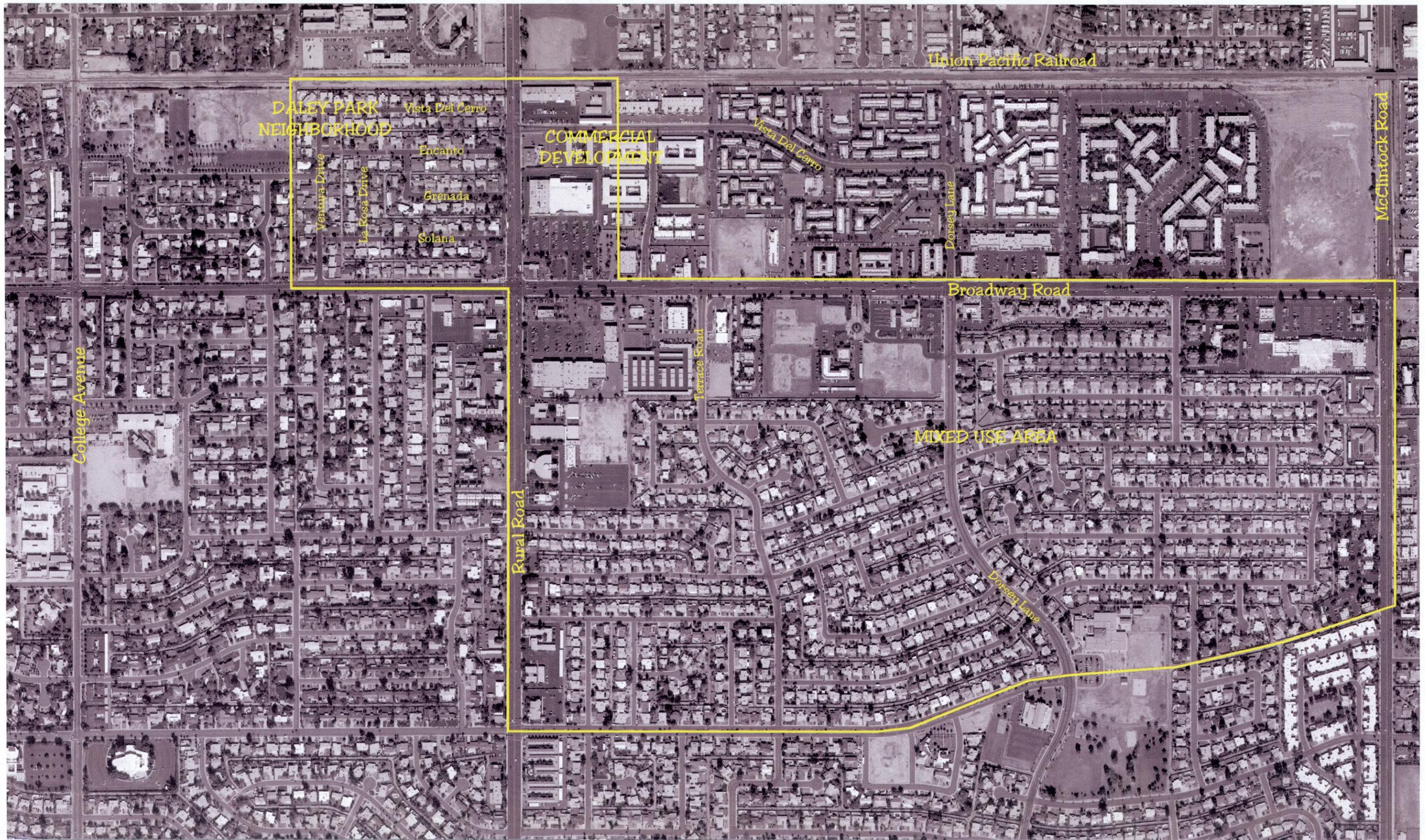


Figure 2 - Rural & Broadway CAR Aerial Photo
Tempe, Arizona

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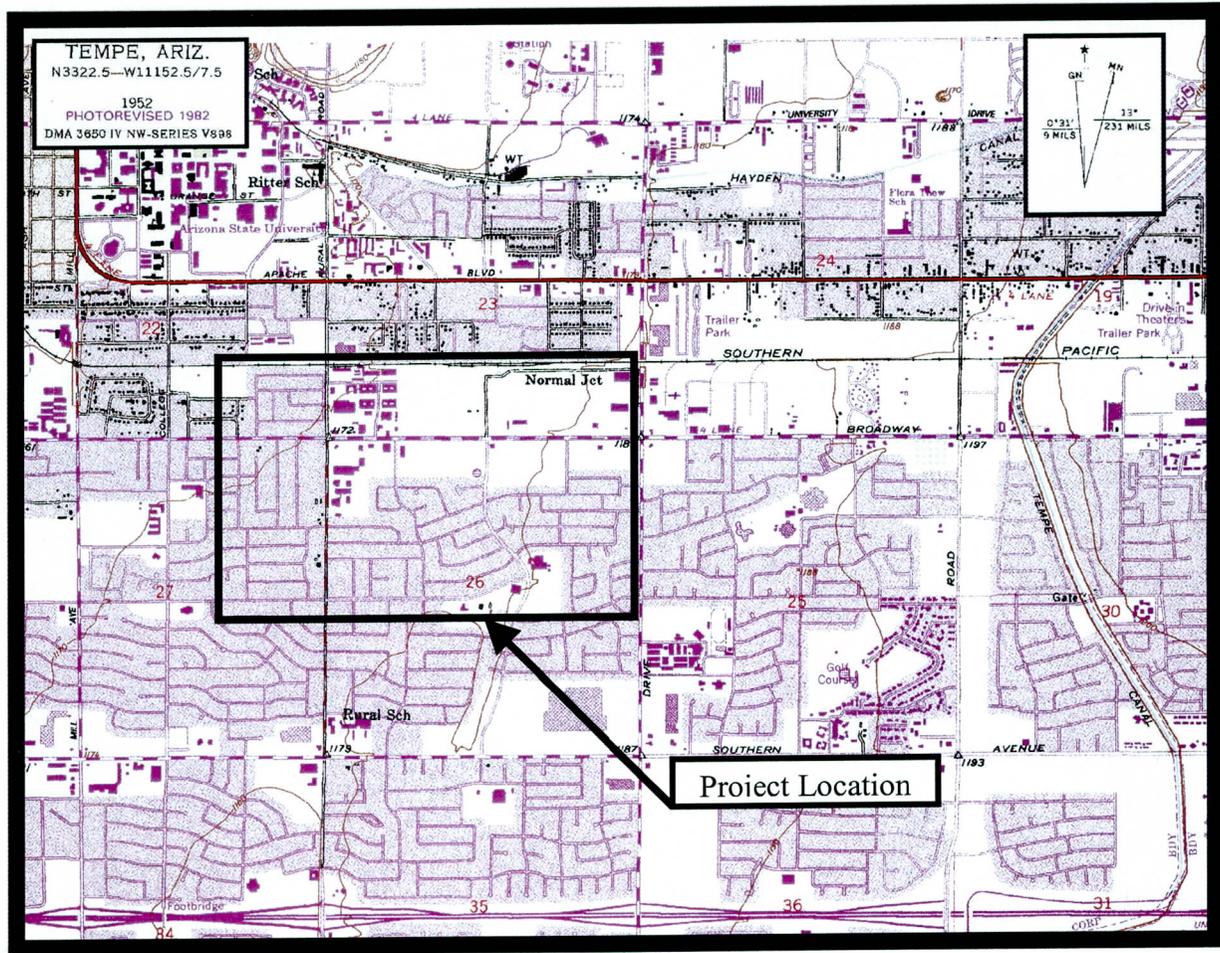


Figure 3 - City of Tempe Area Surrounding Daley Park
Source: USGS Tempe Quadrangle

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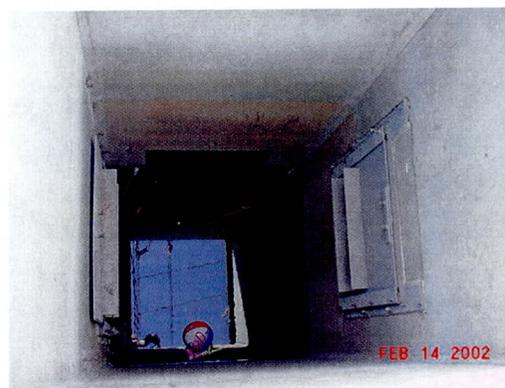
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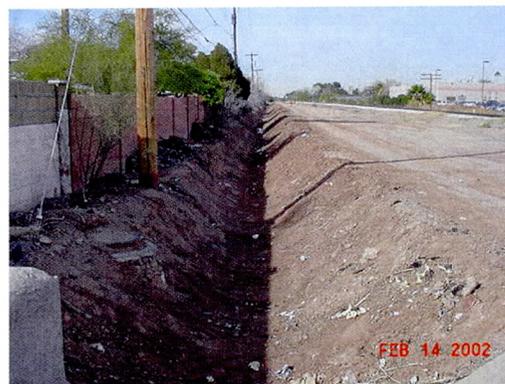
- ⊕ A project by SRP cut off, plugged, and abandoned the original storm drain from the intersection and tied the existing catch basins into the irrigation pipeline. This project was done about 1989. New catch basins were added to collect stormwater in the Daley Park Neighborhood. This pipeline discharges to a structure near the UPRR. The structure is gated and can discharge to the Rural Road storm drain to the east or to an existing SRP drain and pump ditch. Apparently this new configuration did not function well and the neighborhood was still being flooded. It was thought storm water would even “back-out” of the storm drain through catch basins into the neighborhood.
- ⊕ Last year two City projects were completed to help mitigate flooding. No hydrologic studies were done for these projects. A bypass pipeline was added to carry storm water from catch basins on Encanto and Vista Del Cerro and discharge them directly to the storm drain in Rural, bypassing the SRP pipeline. A second project added the attachment of flap gates on the SRP pipeline in two locations to prevent flows from backing out of the catch basins. These projects started May 14, 2001 and completed June 22, 2001. The new arrangement was tested by a storm that came in July of 2001.



SRP Drain and Pump Ditch



SRP Diversion Structure



SRP Drain and Pump Ditch

Most of the streets (at the east end, near Rural Road) in the subdivision have been fitted with catch basins that tie into the irrigation pipeline. The pipeline has been fitted with flap gates to prevent backflow from the pipe into the subdivision. The pipeline discharges into a structure with gates that allow the flow of water into the storm drain in Rural Road, or into an SRP ditch to the west. SRP would prefer that the gate to the ditch remain closed and no stormwater be discharged into their system. Tempe has stated

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that it may require a discharge into the ditch to prevent further flooding in the adjacent subdivision. The pictures above show the SRP diversion structure and the drain and pump ditch

The following neighborhood news item was posted on the Daley Park Neighborhood Web Site.

From the Daley Park Neighborhood Association News Letter:

March 4, 2000

Progress on Rural/Encanto Flooding

Progress on the Rural/Encanto Storm Water Flooding!

The City has retained the firm of Brooks, Hersey Associates to perform the study of the flooding problem along our eastern boundary including the intersection at Rural and Broadway. The intent of the study is to identify the most cost-effective solution. Design work should begin in March and construction should be finished before the next monsoon season. Andy Goh is the Public Works Project Manager.

From the Daley Park Neighborhood Association News Letter:

City Finds Alternate Fix for Encanto St Flooding - 8/10/00

City had Plans to Fix Flooding Before Monsoon, 2000 - (Story/work by Jim Newell, news editor Ernest Kurschat) In 1999, eight homes along Encanto were threatened or damaged by backed up storm water during a severe monsoon storm. Public Works hired an engineering consultant to identify that constriction and plan a retrofit. The City plan had called for: 1) a one way valve on the Encanto junction box, 2) a bypass route at Vista Del Cerro, and 3) access to the SRP junction box valve to divert storm water into the SRP ditch. Work was supposed to begin by mid to late summer.

The storm water that collects at the intersection of Encanto and Rural drains from Rural Road.

The storm water drains north into a 24" pipe, then east through a 30" pipe, then north again to the river through a 42" pipe under Rural Road. Unfortunately, a constriction (dip) occurs in the 30" pipe which slows the drainage.

Slight Change of Plans - Andy Goh, City engineer, had been given verbal assurance from SRP Operations that the retrofit would not be a problem. "However", in the meantime SRP "Legal" Department has identified some serious financial liabilities that accompany "joint-use" pipelines. SRP is trying to get out of the storm water business. This legal chess game between the City and SRP will delay or void the "our one-way valve retrofit".

Alternate Construction Plan to Begin October, 2000 - Andy and the consultant have identified an alternate drain plan that does not require SRP approval. This new plan relies on an easement from our neighbor (at the northwest corner of Rural and Encanto). The city's right-of-way people are working on the legal requirements now. Once the easement is in place the new plan will be formally bid and construction should begin in September. They should begin construction in October.

Andy has not ruled out the one-way valve plan but he suspects the bypass pipeline will be done first.

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2.4 Project Authorization

This project was placed in the CAR program following a request from the City to evaluate the area for participation in projects that may mitigate the flooding problems in the area. The Flood Control District of Maricopa County authorized the CAR project to determine if there is sufficient information to evaluate the proposal. The authorization includes the gathering of pertinent data and the presentation of the data in the form of a report.

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3.0 EXISTING CONDITIONS

3.1 Hydrology

The City, in their request for this CAR, stated that there are no existing hydrology studies for the area of Tempe potentially draining to Rural Road and Broadway Road intersection and the Daley Park Neighborhood. A problem has been identified at these locations, but the magnitude of the problem cannot be evaluated reasonably without hydrology data; specifically a hydrologic model.

Due to the size of the potential drainage area and the complexities of an urban storm drain system (various sizes, different discharge locations, and tie-ins with irrigation pipelines), a HEC-1 model would be required to suitably model the area contributing to the flooding at Rural and Broadway Roads.

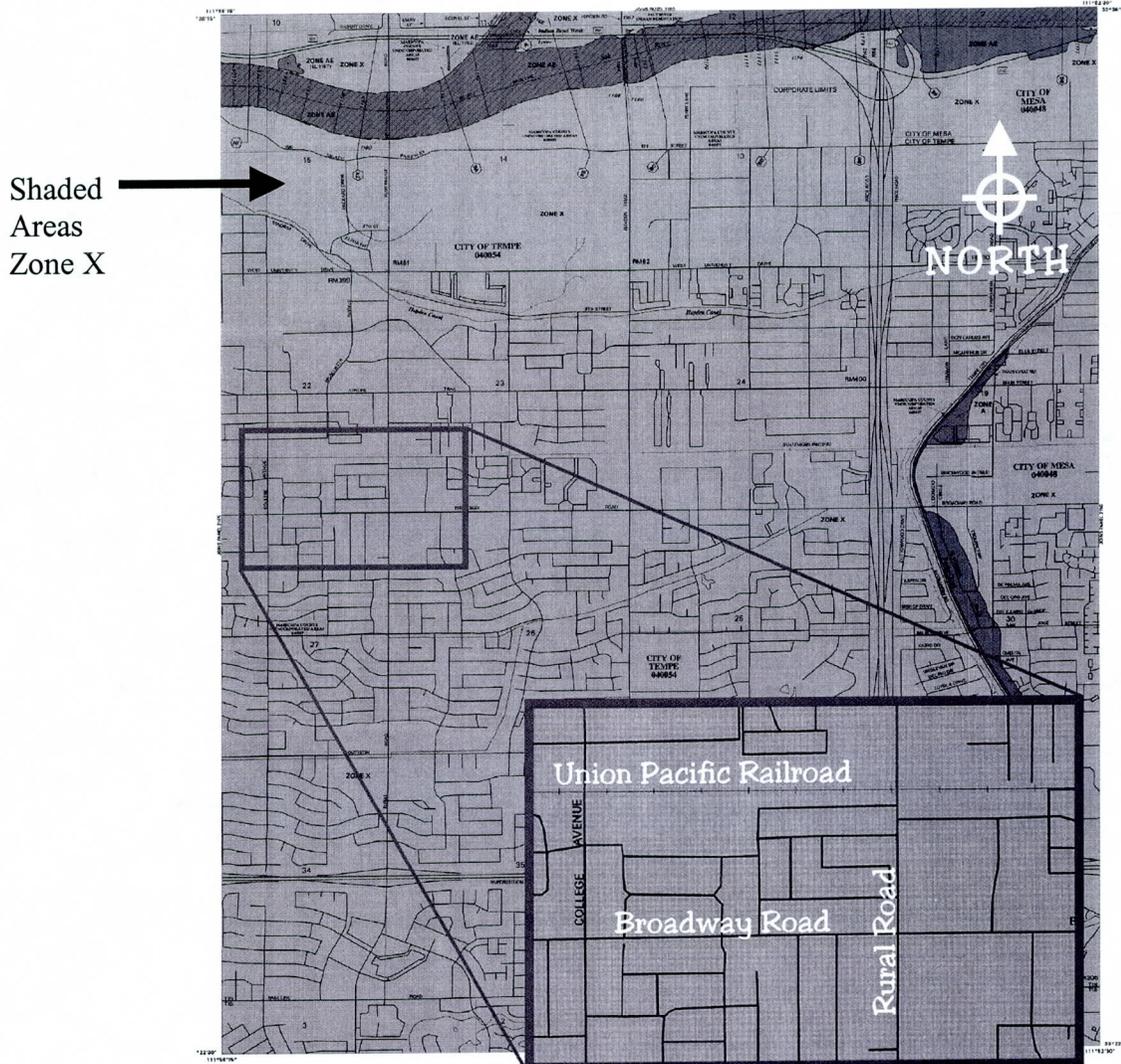


Figure 5 - Floodplain Map for Tempe, Arizona
Source: Community Panel Number: 04013C 2170 F
Effective Date: July 19, 2001

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A search of the FEMA mapping for Tempe provided information that this area is not in a FEMA mapped flood plain for the 100-year flood. The area has been determined to be in Zone X. This is “Areas of 500-year flood, areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.” Figure 5 is a copy of the Flood Map Community-Panel Number 04013C 2170 F.

3.2 Watershed Description

The potential area draining to the intersection of Rural and Broadway Roads, and into the Daley Park Neighborhood is located in north Tempe, Arizona, and is described by the following three sub-areas:

- ⊕ Daley Park Neighborhood which is bounded by Union Pacific Railroad, Ventura Drive, Broadway Road and Rural Road,
- ⊕ the commercial plaza at northeast corner of Rural and Broadway, and
- ⊕ the mixed use area bounded by Rural Road, Alameda Drive, McClintock Drive and Broadway Road.

Figure 6 shows the study drainage area. The total potential drainage area is about 348 ac, and generally slopes to the northwest. The potential drainage area is mostly older developments that were developed before any requirement for retention.

The Daley Park Neighborhood (38 ac) is a low-density residential area with no-retention. The northeast and northwest corners of the neighborhood are the stormwater concentration points of the watershed. Figure 7 shows the direction of flow in the streets for Daley Park Neighborhood as well as the rest of the watershed. Catch basins are located at the concentration points to collect drainage. These catch basins discharge into the storm drains in Rural Road and to an SRP irrigation ditch along the south side of the UPRR right-of-way. Figure 8 presents the existing storm drains in the study drainage area.

The commercial plaza at the northeast corner of Rural and Broadway is about 10 acres. About 4 acres has 100-year-on-lot retention and drains to a retention basin included in the parking lot of the development. Other portions discharge storm water to Rural Road.

The mixed-use area (southeast of the Rural and Broadway intersection) is mostly residential but has a mixed commercial, recreation, and school component. Included within its 300 acres are approximately 12 acres of 100-year on-lot retention and about 43 acres of 5-year on-lot retention. Storm water runoff from this area is directed to Rural Road south of Broadway and to Broadway Road east of Rural. There is no storm drain provided in Rural Road between Alameda and Broadway Road. Flows on Rural Road are conveyed in the street northward to the intersection of Broadway Road. Storm drains exist in Broadway Road and capture water in catch basins on both sides of the roadway and convey it to the storm drain in Dorsey Lane, ½ mile east of Rural Road. The Dorsey Lane Storm drain continues north across the railroad and out of the study area. If this storm drain should reach capacity, the flows in Broadway will continue to the west and concentrate at the intersection of Broadway and Rural Roads. This potential for excess stormwater to reach Rural and Broadway extends the potential drainage area along Broadway to McClintock Road. The area north of Broadway between Rural and McClintock is concentrated at the storm

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drain in Dorsey and does not contribute to the flooding at the intersection or in the Daley Park Neighborhood.

3.3 Existing Hydrology Models

As previously noted, there are no existing hydrologic models for the area to define the magnitude of the flows that discharge to the flood prone area. A rain gauge operated by the District is located within a quarter mile of the flooded homes. This gauge and a video of flooding in the area have provided some documentation of the flooding problem in the neighborhood.

On July 29, 2001 some time after 10:00 p.m. a monsoon thunderstorm developed over Tempe. A resident of the Daley Park Neighborhood provided a videotape of the flooding to the City staff. The video shows the flooding at the intersection of Broadway and Rural Road. Much of the flow is curb deep and appears to be flowing north along the east side of Rural Road. The stormwater is fully across Broadway Road east of Rural and it appears to be fully across Rural on the south side of Broadway. The video also shows the stormwater crossing Rural Road south of Encanto Drive eventually flowing into Encanto Drive. Encanto Drive appears to be flooded. Photo clips from the videotape are provided in Appendix A. From field visits and documentation provided by the City, it appears that the flow reaching the Daley Park Neighborhood may come from the east up to a mile away. Stormwater collects in Broadway Road and flows to the west to Rural Road. Flows that collect in Rural travel north to Broadway. The flows combine and continue north and cross at a sag point on Rural and flow into Encanto Drive.

Although a flood mitigation project by the City was completed June 22, 2001 prior to the July 29, 2001 storm, flooding still occurred in the neighborhood and at the intersection.

Catch basins collect flows at the intersection of Rural and Broadway Roads and a storm drain system using SRP irrigation pipes conveys the water to the north. A separate system begins immediately west of the intersection and conveys flow in Broadway Road to the west and out of the study area. A separate system in Rural Road near the railroad conveys stormwater to the river through a storm drain in Rural Road. An irrigation pipeline that discharges to the storm drain in Rural drains the Daley Park Neighborhood. The City provided information maps for the storm drains in the area. The SRP provided maps, plans, and as-builts for irrigation pipelines. Figure 9 is a schematic of these pipelines. More information may be found in Appendix B.

The July 29, 2001 storm was recorded at the Districts "ASU South" gauge and is the 3-hour record rainfall for the gauge. A total of 1.3 inches of rainfall fell in about 1½ hours. The intensity peaked at about 1.9 inches per hour. Using the software provided by the District (PreFre) the rainfall data was estimated to be around a 5-year storm. Further study and investigation by the District determined the storm to be between a 2- and 5-year frequency. According to the City, street catch basins are designed to intercept the 10-year storm. Storm drains in these same locations may not be designed to the 10-year storm. This storm appeared to overwhelm the storm drain system and filled the streets. The runoff ponded in the Daley Park Neighborhood until capacity was available in the Rural Road storm drain. Rainfall for the July 29 storm, and gauge data are provided in Appendix C.



FIGURE 6

CONTRIBUTING DRAINAGE AREA MAP

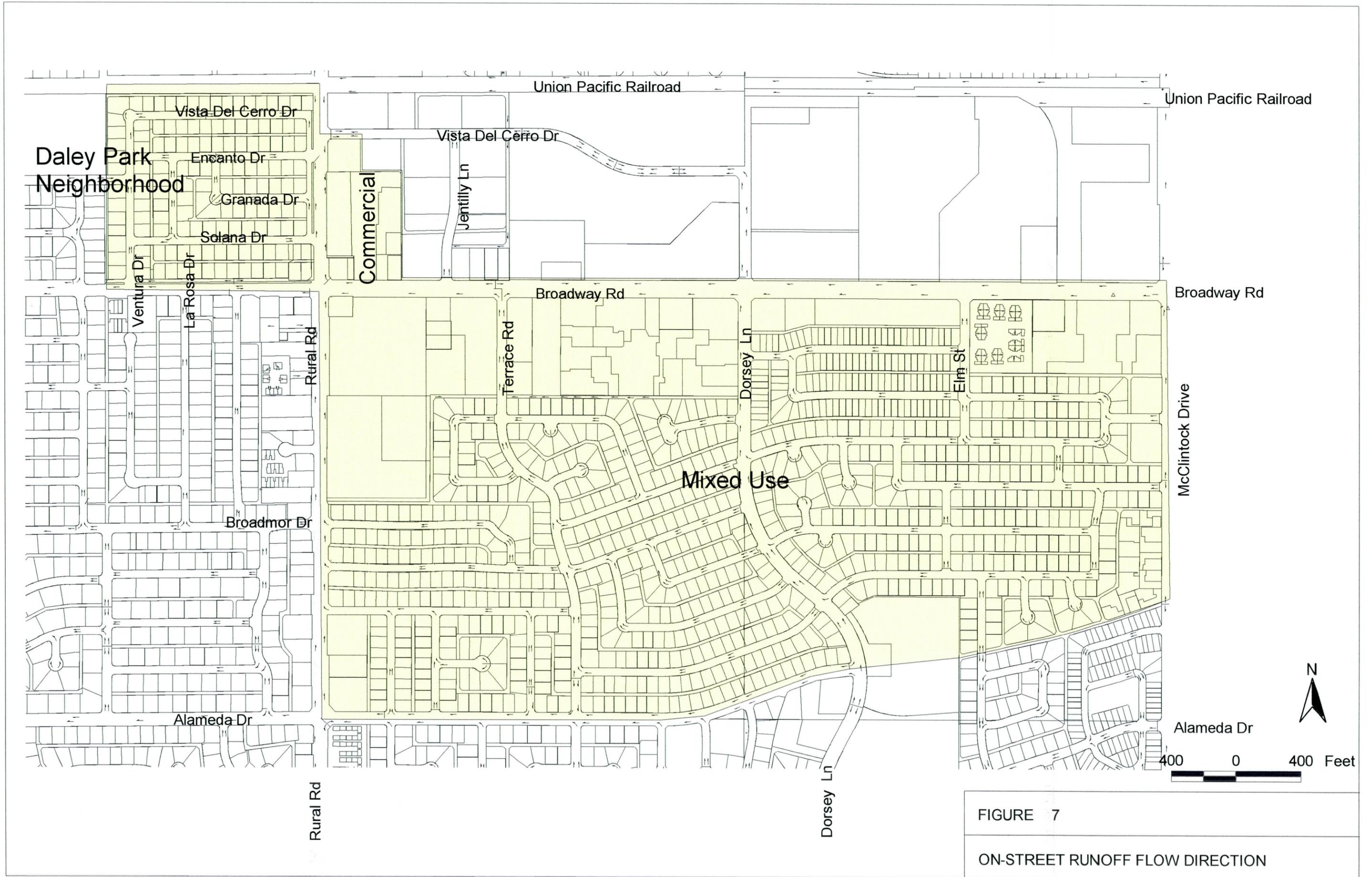


FIGURE 7
ON-STREET RUNOFF FLOW DIRECTION



FIGURE 8

STORM DRAIN



FIGURE 9
IRRIGATION PIPES

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3.4 Existing Development Drainage Reports

The City does not archive or record any drainage documentation for developments within its jurisdiction. Much of the development in the watershed for Daley Park was constructed prior to the requirements for drainage design. The City did provide GIS information that shows the area by development and under what retention policy it was developed. Figure 10 is a graphic showing the boundaries of these areas.

3.5 Existing Facilities

Daley Park Neighborhood was developed before the City enacted any retention policy. Figure 11 provides a graphical look at the existing storm drain facilities on the eastern edge of the subdivision. In the late 80's a project was completed by SRP where the existing storm drain in Rural Road was plugged and abandoned. A pipe was installed to carry irrigation water from a diversion box at the southeast corner of Rural and Broadway to another diversion box at the railroad. This diversion box can discharge to an SRP ditch at the UPRR or the storm drain in Rural Road. SRP prefers that the flow go to the storm drain and the ditch gate is locked down. The City is prepared to open this gate and allow flow to discharge to the SRP ditch should the area become flooded. The irrigation pipeline was connected to catch basins at various locations along Rural Road and in the neighborhood. In 2001, about one year ago, another project was completed by the City to try to mitigate flooding in the neighborhood. This project added a second pipeline between the catch basins on Encanto Drive and the catch basin on Vista Del Cerro Drive that discharges to the 42" storm drain in Rural Road. Two flap gates were also added to the inside of the irrigation junction boxes where the catch basins at Encanto and Granada Drives discharge. This was done in an effort to prevent flows from backing out of the pipeline and flooding the neighborhood.

There is another storm drain along the Daley Park Neighborhood in Broadway Road. Catch basins begin on the frontage road just east of Rural and Broadway Road. This storm drain continues to the west along Broadway Road and out of the study area.

Finally an existing drainage pipe in the Daley Park Neighborhood drains stormwater flows from the northwest corner of the subdivision. A catch basin at the corner of Ventura Drive and Vista Del Cerro Drive that collects stormwater flow from the neighborhood and discharges it to the SRP ditch along the UPRR.

Storm drains convey flows from the study area at three locations. These include the storm drains on Dorsey Lane (to the north), Rural Road (to the north), and Broadway Road (to the west). The approximate capacities of these conveyances have been calculated using the Manning's Equation and are presented in Figure 12.



FIGURE 10
 EXISTING DEVELOPMENT RETENTION

SRP open drain and pump ditch

Union Pacific Railroad

42"

Vista Del Cerro Dr

24"

18"

36"

Vista Del Cerro Dr

Ecanto Dr

30"

Flap gate

Granada Dr

Flap gate

Rural Rd

30"

Solana Dr

30"

30"

Broadway Rd

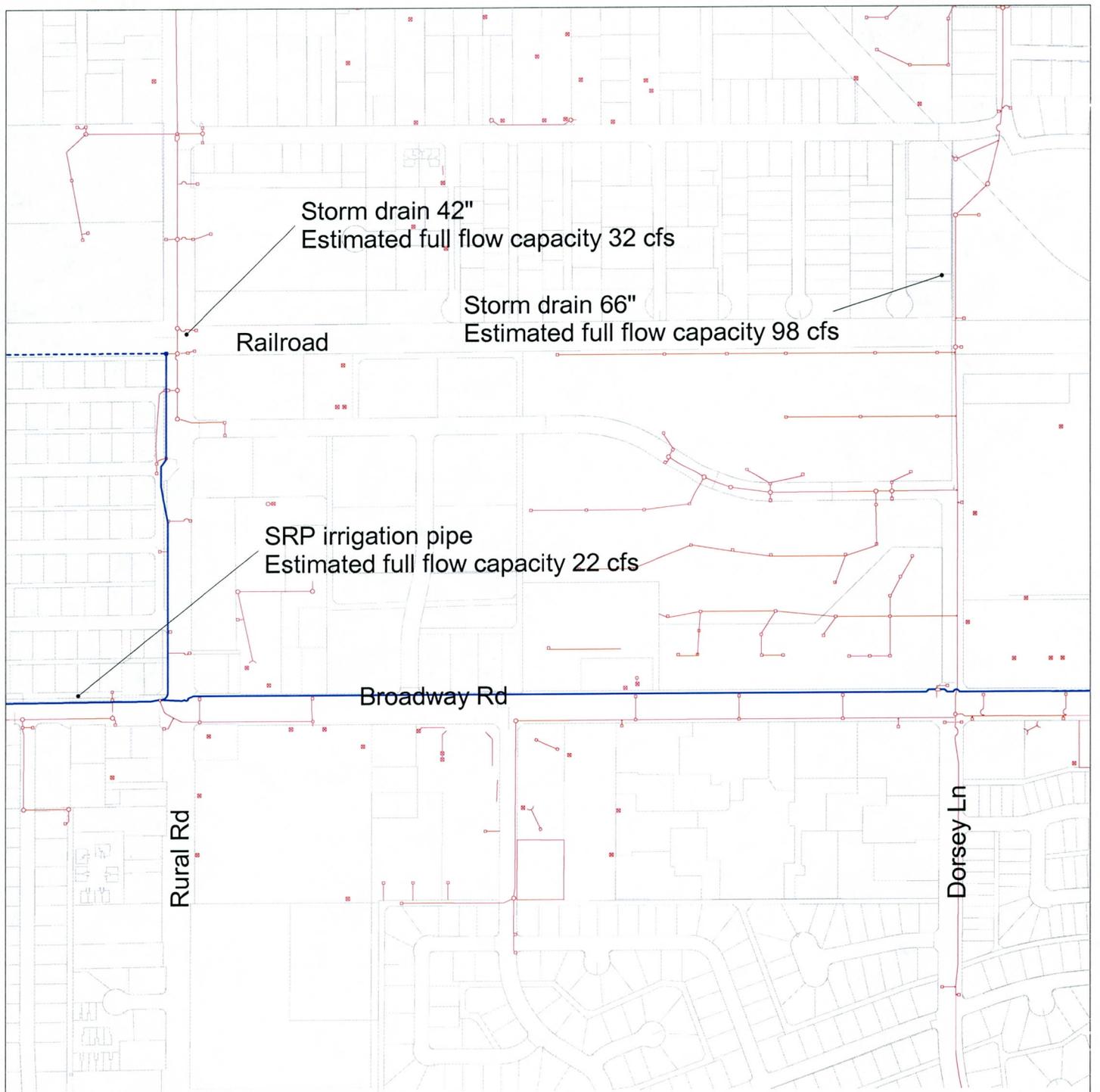
Legend

-  Irrigation pipe
-  Storm drain
-  Dry well
-  Catch basin



FIGURE 11

STORM DRAIN/IRRIGATION PIPE - RURAL RD



Legend

-  Irrigation pipe
-  Storm drain
-  Dry well
-  Catch basin



FIGURE 12

STORM DRAIN DISCHARGE CAPACITIES

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3.6 Modal

3.6.1 Vehicular

The Daley Park Neighborhood is a residential neighborhood and includes only residential class streets. These streets are paved with curb, gutter, and sidewalk. Traffic is light as there are no “through” streets and no businesses within the subdivision. Within the study area are the major city streets of College Avenue, Rural Road, Dorsey Lane, and McClintock Road are the north-south aligned streets. Broadway Road and Alameda Drive are the major east-west streets. Apache Boulevard is just north of the study area and Southern Avenue outside the south boundary of the study area. Rural Road and Apache Boulevard (outside the study area) are listed in the City’s General Plan as “Proposed High Capacity Transit” routes. Figure 13 shows the City’s proposed transit plan.

3.6.2 Freeways

Freeways bound the drainage area but are several miles away. The Superstition Freeway (US60) is approximately one and a half miles to the south of the neighborhood and the Price Road Expressway (SR101) is located approximately two miles to the east. Each of these freeways are below grade and prevent any drainage from the other side of the freeway to drain to this area. The Red Mountain Freeway (SR 202L) follows along the north bank of the Salt River and is about two miles to the north.

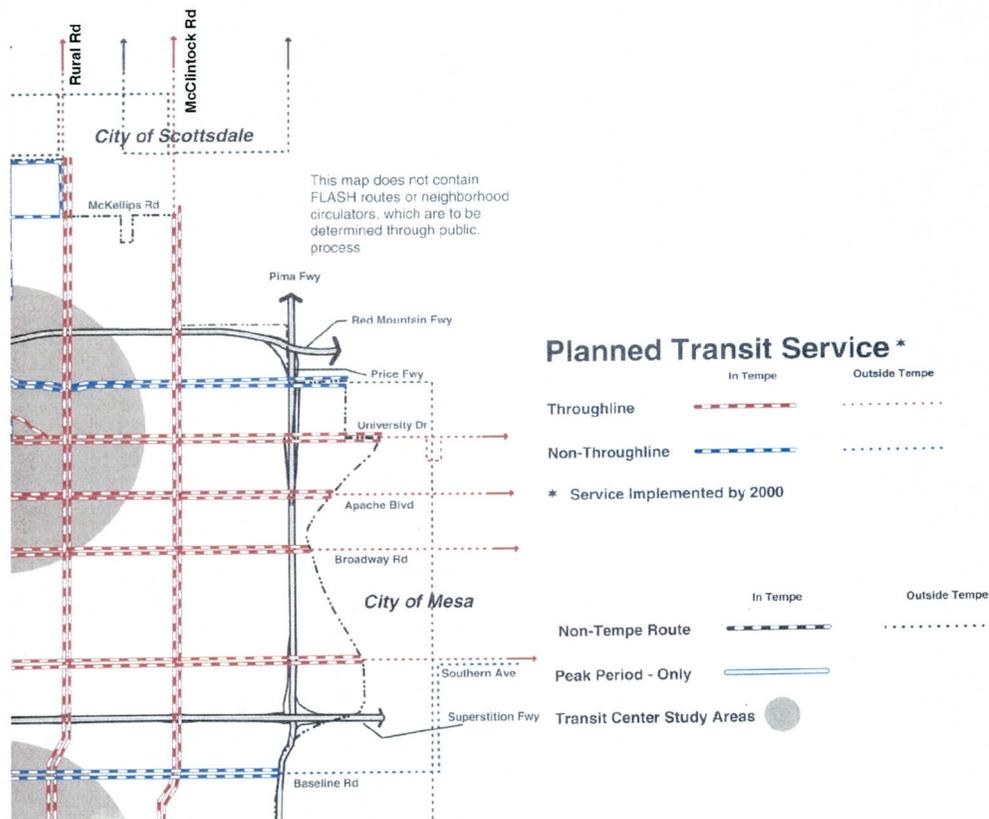


Figure 13 - City of Tempe Planned Transit Facilities
Source: General Plan 2020

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3.6.3 Major Streets

Most streets in the City are laid out in a grid pattern with the major streets each mile. Rural Road and Broadway Road, both major streets bound two sides of the neighborhood the east and the south, respectively. The City General Plan 2020 list Rural Road as a “Proposed High Capacity Transit” facility in the Central Corridor. The plan also shows that both Broadway and Rural Roads as “Through Line” transit corridors. Traffic counts for the section of roadway adjacent to Daley Park Neighborhood are given in the following table:

Table 1 – Broadway Road Traffic Counts

Broadway Road (Years)	McClintock to Rural	Rural to Mill
2001-2002	34,499	32,270
1999-2000	35,671	32,636
1997-1998	33,436	34,530

Table 2 – Rural Road Traffic Counts

Rural Road (Years)	Apache to Broadway	Broadway to Southern
2001-2002	N/A	43,712
1999-2000	51,488	41,520
1998-1999	54,823	47,614

Traffic counts in the preceding tables represent average traffic volumes for an average 24-hour period.

3.6.4 Bridge Crossings

There are no bridge crossings in the Daley Park Neighborhood area. No washes, streams, rivers, drainage channels or open canals in or near the neighborhood. Only the SRP irrigation ditch labeled as an “Open Drain and Pump Ditch” on the SRP’s Zanjero Area Maps (See Figure 4). There are no bridges or crossings over this ditch.



SRP Open Drain and Pump Ditch

Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



3.6.5 Railways

The Union Pacific Railroad is the current owner of the railroad and right-of-way on the north side of the Daley Park Neighborhood. The railroad embankment is three to four feet above existing ground in the area. The railroad has one culvert crossing in the area of the study. This crossing shown in the pictures on this page is a double barrel concrete pipe culvert crossing.



Railroad Culvert Crossing Outlet

The culvert is located about a quarter mile east of Rural Road at the border of the private homes and Daley Park. The culvert outlet is mostly filled with sediment and inlet is perched above the invert of the upstream irrigation ditch. One of the barrels is cut off from the



Railroad Culvert Crossing Outlet

main channel and most likely does not convey flow across the railroad before it breaks out to the west. Railroad plans provided by the UPRR show other culvert crossings that have been eliminated. None of these crossings, if still existing would prevent or mitigate flooding in the Daley Park Neighborhood. Appendix F includes UPRR Right-of-Way Plans. Figure 14 shows the lines and subdivisions for the UPRR.

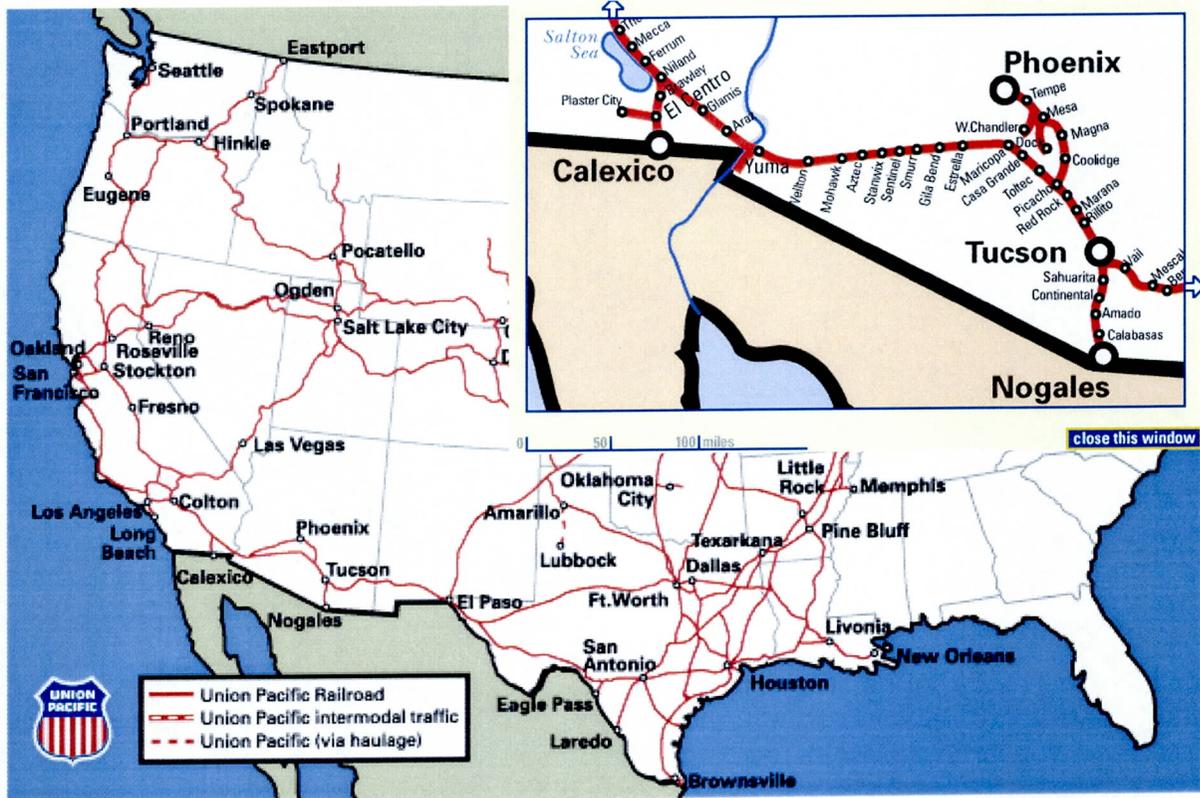


Figure 14 - Union Pacific Railroad Lines and Subdivisions

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Flood Control District of Maricopa County, Arizona...



3.6.6 Bikeways

The City, in the General Plan 2020, has identified existing and proposed bikeways throughout the City. The bikeways pass adjacent to, and around the Daley Park, but none cross through the neighborhood. Within and around the study area existing bikeways are located on Vista Del Cerro (east of Rural), College Avenue, McAllister Avenue (north of the UPRR), and Alameda Drive. Other routes are proposed along the UPRR, Broadway Road, and Apache Boulevard. A proposed bike path is also identified along Rural Road with connecting paths at Broadway Road, Apache Boulevard and the UPRR. Figure 15 shows the bikeways as presented in the general plan.



Figure 15 - City of Tempe Bicycle Facilities Master Plan
Source: General Plan 2020

Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



3.6.7 Trails

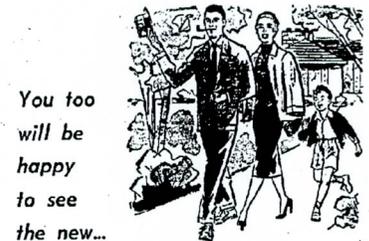
The City, in the General Plan 2020 has identified as a part of the Transportation Element, a Pedestrian Plan. Tempe is near fully developed and has no real property as open space to dedicate to trails development. The plan has identified, however, that adding amenities such as lighting, seating, water, shade, etc might enhance pedestrian traffic on existing streets. Furthermore, the City will attempt to incorporate such off-street locations for trails along existing infrastructure such as canals, railroads, and utilities easements. While no trails maps are included in the plan, the bikeways are identified as combined use facilities for bicycles and pedestrians.

3.6.8 Summary of Modal Characteristics

Daley Park Neighborhood is neither a major destination nor generator of trips using any mode of transportation. Dwellings are all single-family homes on single lots. A portion of the homes may be rented, but there are no apartments. Nearly all modes of transportation are available to the residents of the neighborhood. Adjacent streets are major corridors and support the nearly all the various modes of transportation available to the citizens of Tempe.

3.7 Socioeconomic Environment

The Daley Park Neighborhood appears to be an upper-middle-class neighborhood and is located adjacent to the main campus of Arizona State University (ASU). Dwellings in the neighborhood are single-family type homes built in the late 1950s. Most are block construction with grass yards. According to the Maricopa County Assessors calculations, the average home in the area is 1440 Square Feet and has a comparable sale value of \$157,770. The homes appear to have a higher than average value due to the proximity to down town Tempe and ASU. The table below presents the county assessors information.



You too
will be
happy
to see
the new...

MODEL HOME in University Heights

2 Blocks East of College Avenue Just East of the New City Park

NOW OPEN
\$11,995

3 bedrooms, 1 1/2 baths, covered rear patio, sliding glass doors, underground parking, lawn, city paved streets, center.

all for
\$1,500 Down, including all closing costs

Refrigeration Optional in Any Home

Several Other Plans to Choose From - Nearby

Owned and Developed By

Karl S. Guelich

Real Estate & Construction

525 Mill Ave. Tempe, Arizona Phone WO 7-3379

Ad from the 50's for homes in what is now known as the Daley Park Neighborhood

Table 3 – Comparable Home Values for Daley Park Neighborhood

Parcel	Land Size	Sales Price	Sales Date	Full Cash Value	Livable Square Feet	Value/Square Feet	Built	Address
097	7571 SF	\$ 168,750	Jan-02	\$ 116,000.00	1497.0 SF	\$ 113	1957	751 E Granada
031	6961 SF	\$ 162,000	Jun-01	\$ 111,500.00	1392.0 SF	\$ 116	1958	1741 S Ventura
082	7701 SF	\$ 153,000	Feb-01	\$ 116,000.00	1399.0 SF	\$ 109	1957	N/A
101	7275 SF	\$ 190,000	Jan-01	\$ 120,500.00	1566.0 SF	\$ 121	1957	727 E Granada
002	6338 SF	\$ 118,500	Nov-00	\$ 107,000.00	1344.0 SF	\$ 88	1961	738 E Vista Del Cerro
Averages	7169 SF	\$ 158,450		114200.0 SF	1439.6 SF	\$ 110		

Source: Maricopa County Assessors Office

Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



3.7.1 Jurisdiction and Ownership

Daley Park is a residential neighborhood with most or all homes privately owned. There are no businesses in the neighborhood. A commercial development is located at the northwest corner of the Rural and Broadway Roads. The City is the owner of the adjacent roadways of Rural and Broadway Roads. The Union Pacific Railroad bounds the north border of the subdivision. The entire area, both the neighborhood and the area that potentially drains to the neighborhood is within the jurisdiction of the City.

3.7.2 Land Use and Zoning

The Daily Park Neighborhood and the surrounding areas are mature neighborhoods and have been fully developed for many years. Zoning is set by the existing development and is modified for by hearing for special areas and for re-development. There is currently a few sites of reconstruction or redevelopment within the potential watershed for the Daley Park Neighborhood. These new developments must adhere to the current drainage ordinances. Current drainage ordinances for the City may be found in Appendix D

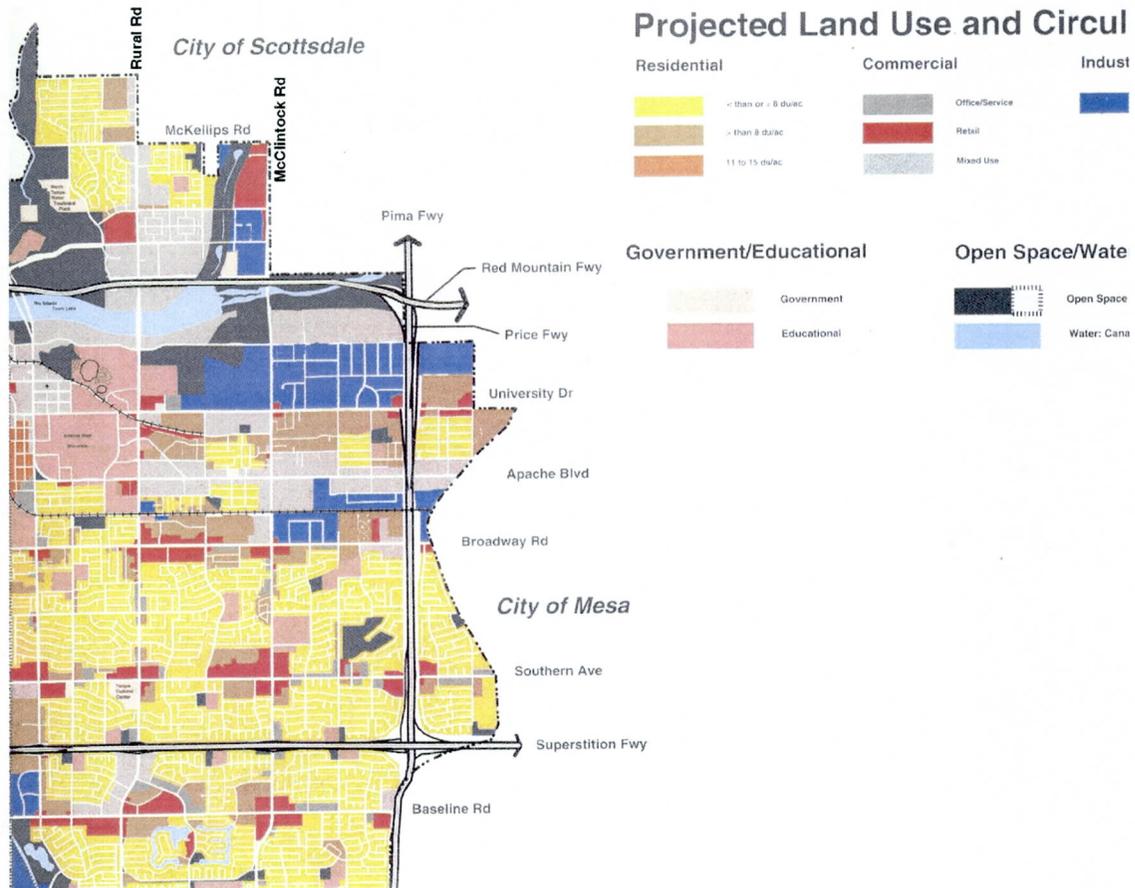


Figure 16 - City of Tempe Land Use Plan
Source: General Plan 2020

Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



3.7.3 Population

No statistics have been obtained specifically for the Daley Park Neighborhood. The census tract for the 1995 Special Census area (between University, Broadway, Kyrene, and Rural) that includes the neighborhood however lists the following statistics:

Table 4 – Area Demographics (Part I)

Census Tract	Total Population	18 Yeas & Over	55 Years & Over	Median Age	Working Population	Student Population	Retired Population
319000	3959	3674	288	22	1026	2474	178

Table 5 – Area Demographics (Part II)

Census Tract	Total Population	Male	Female	White	Black	American Indian	Asian	Other	Total Hispanic	Total Non-Hispanic
319000	3959	2015	1944	3345	123	62	126	27	276	3683

Source: City of Tempe Web Site

These numbers do not reflect the exact totals for the Daily Park Neighborhood but they give a good idea of the demographics of the general vicinity.

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Flood Control District of Maricopa County, Arizona...



4.0 Summary

4.1 Problems

It is obvious that as the storm water system currently exists, there has been and will continue to be flooding at the intersection of Broadway and Rural Roads and the Daley Park Neighborhood as depicted by the flooding video taken following the July 29, 2001 storm. Comments from the City regarding damages are also evidence of the flooding problems in this area. This includes items such as carpet replacement and holes in back yard fences that have been punched through to allow drainage from properties into the SRP drain and pump ditch



Hole punched in fence to provide drainage to SRP ditch

The items that contribute to the flooding of the Broadway and Rural area can be summarized as follows:

- Insufficient Storm Drain Capacity
- Use of Irrigation Pipeline as Storm Drain
- Use of Irrigation Ditch as Outfall
- Older Neighborhoods in Watershed Built With No Retention
- Inadequate Floor Elevations in Homes
- Inadequate Conveyance Under Railroad
- Manually Operated Gates for Excess Storm Flow Discharge

4.2 Conclusions

Significant and frequent flooding impacts the Daley Park Neighborhood and the intersection of Broadway Road and Rural Road. This report documents the flooding problems in the area and identifies the existing information available regarding drainage and storm water conveyances. The following three steps are recommended for further investigation of this flood prone area.

Step 1 – Hydrologic Study

A key piece of data that is not available for this area is a hydrologic study. A hydrologic model would define the location and the magnitude of the flooding problems. Any development of drainage solutions to the problems in the Daley Park Neighborhood and the flooding of Broadway Road and Rural Road would require that a hydrologic model be developed. The model should incorporate the existing storm drains as well as the irrigation pipelines and ditches used as storm drains.

Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



The model should include various frequencies of storms using 6- and 24-hour duration models. These various models would allow for the selection of the optimal design storm for the area based on a reasonable level of service. The storms that have been documented to cause flooding the area are typically the summer thunderstorms that are very short in duration and very intense in magnitude.

Step 2 – Flood Delineation Map

A more defined area of impact should be known. The area of flooding should be delineated and a map created based on the hydrology and possibly a hydraulic model. This map would show the properties impacted by flooding. From this a damage assessment could be determined based on the value of the impacted properties. This damage assessment would be the basis for comparison of possible flood control or drainage facility alternatives.

Step 3 – Develop Alternatives

Based on the hydrologic model and the flood area delineation impact map various solutions could be developed. Multiple solutions should be investigated and the optimal solution determined from these alternates. Using the hydrologic model and based on the level of protection desired the magnitude of the flooding could be used to determine the feasibility of alternate drainage solutions. The Daley Park Neighborhood group should be involved in the process of identifying acceptable solutions. Among the possible solutions are the following:

- ⊕ Determine flood prone properties and submit for inclusion into the National Flood Insurance Program.
- ⊕ Increase the conveyance within the existing storm drain corridors.
- ⊕ Provide new storm water conveyance and outlets from the area.
- ⊕ Provide upstream detention basins along main conveyance corridors to reduce peak flow into the area.
- ⊕ Provide downstream detention to store floodwaters collected in the storm drains. This could require new storm drain to collect stormwater from flood prone areas and the use of existing conveyances to convey storm water out of the area when capacity is available.
- ⊕ Purchase and raze homes in flood prone areas and use the property as retention/detention areas.
- ⊕ Others developed during the project and public process.

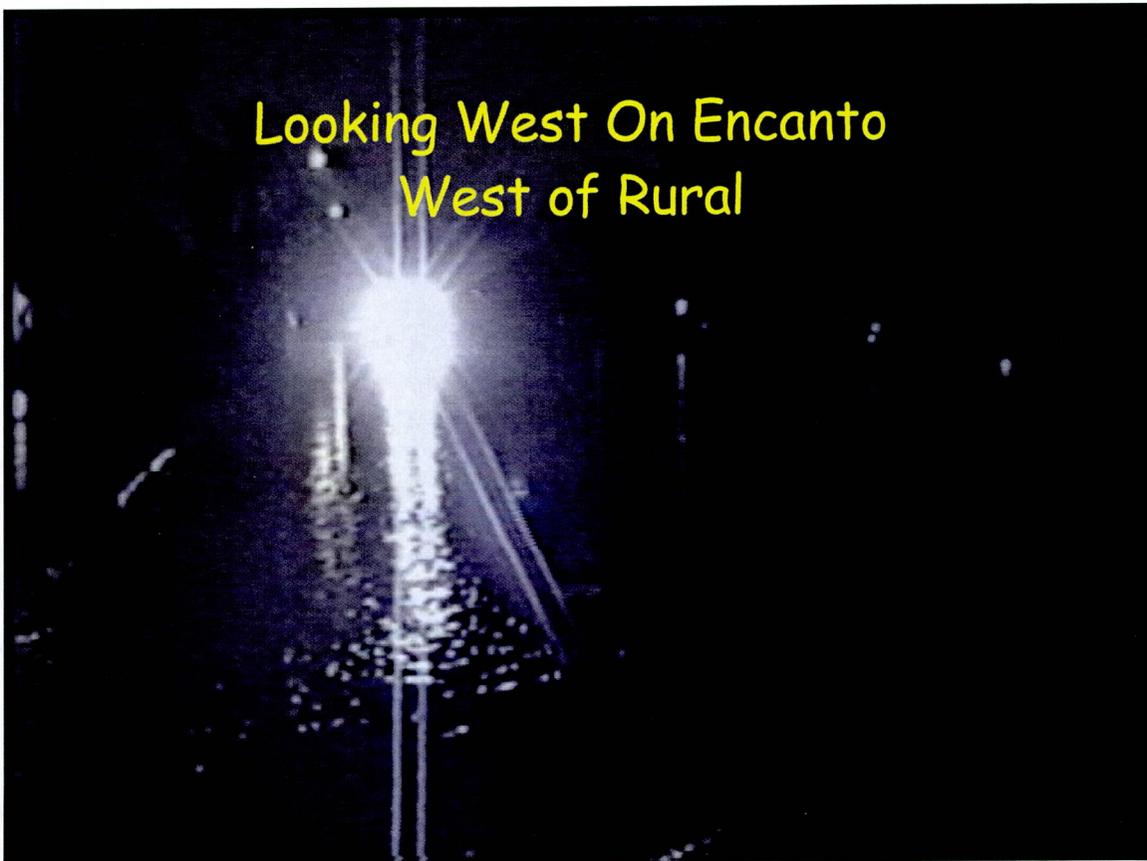
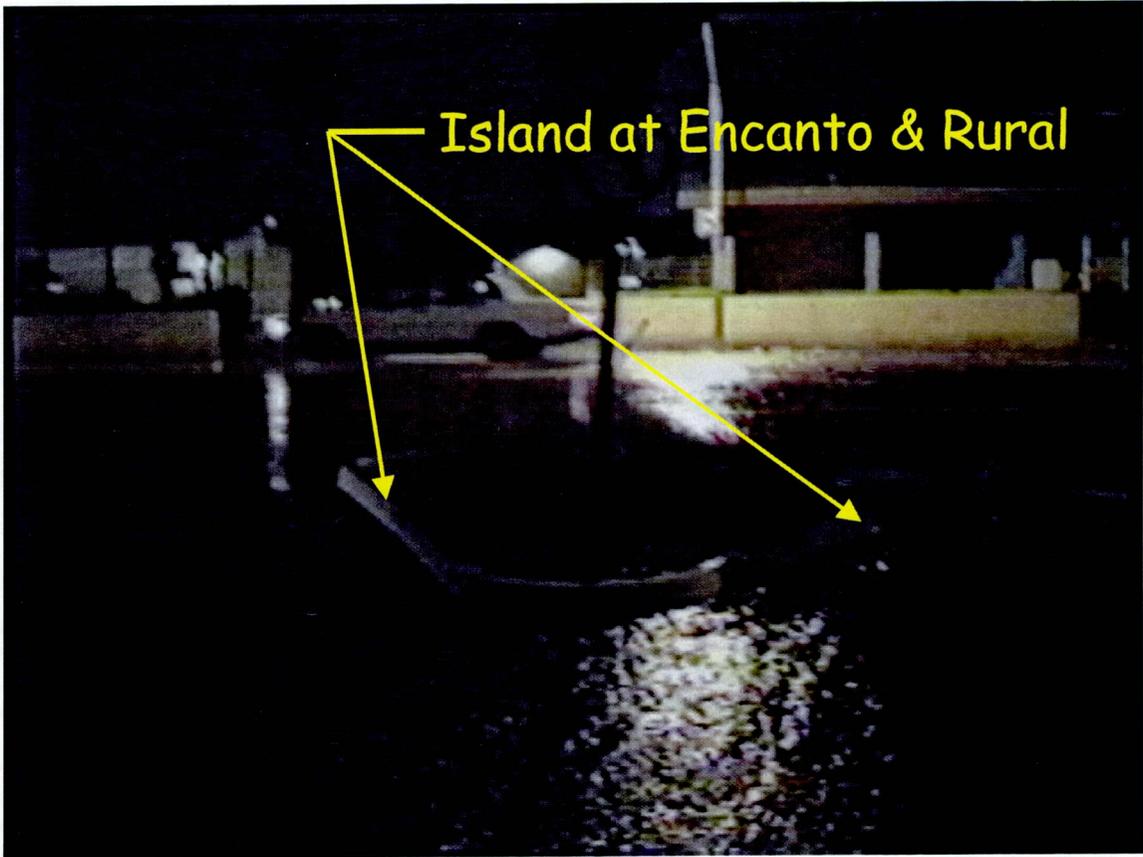
The costs of each solution that would mitigate flood damage should be compared to the benefits derived according to the determined level of protection. If an acceptable solution is identified it could be developed further as a flood control project.

Candidate Assessment Report: Rural & Broadway

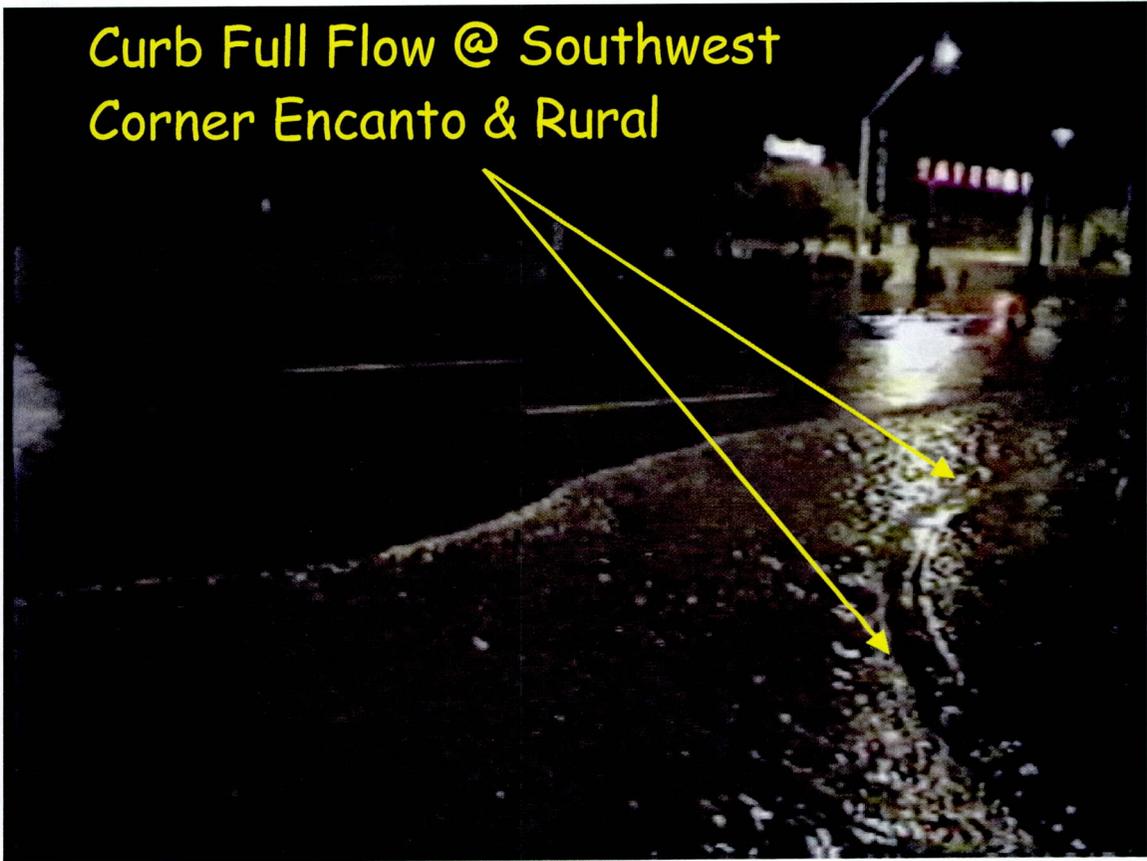
Flood Control District of Maricopa County, Arizona...



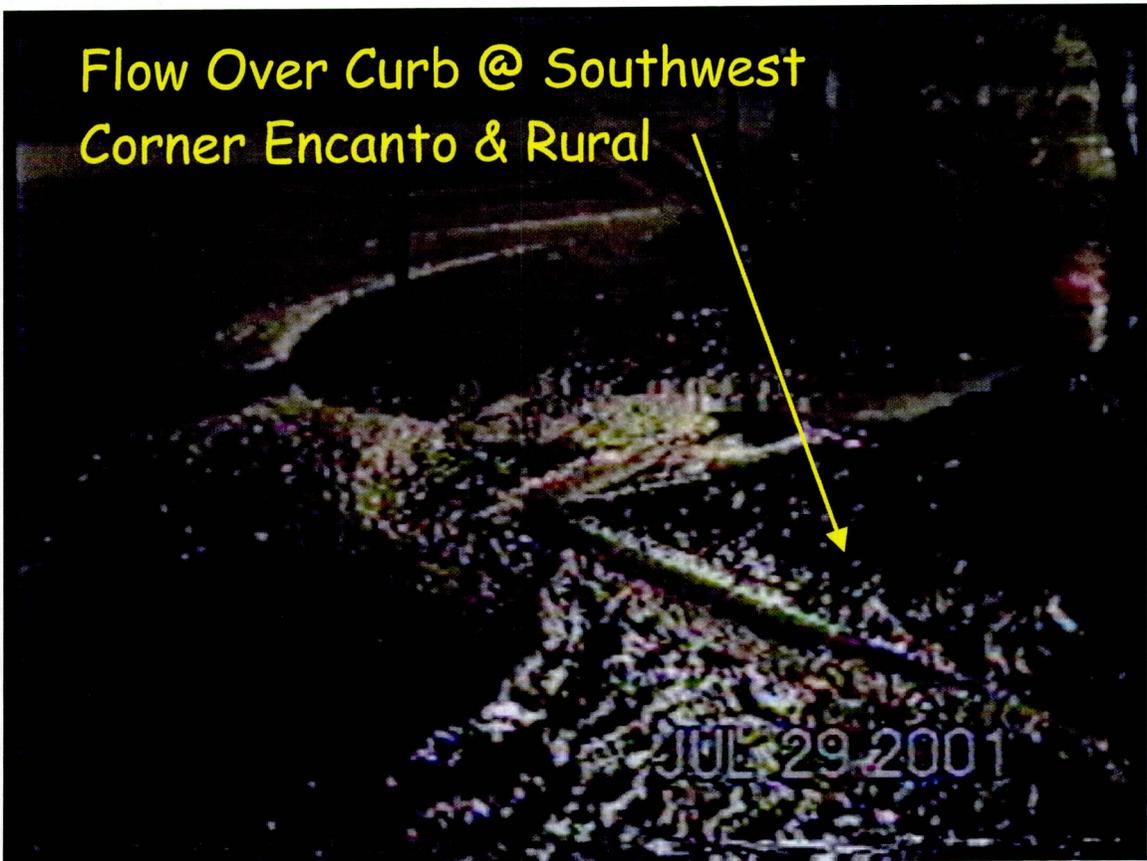
APPENDIX A



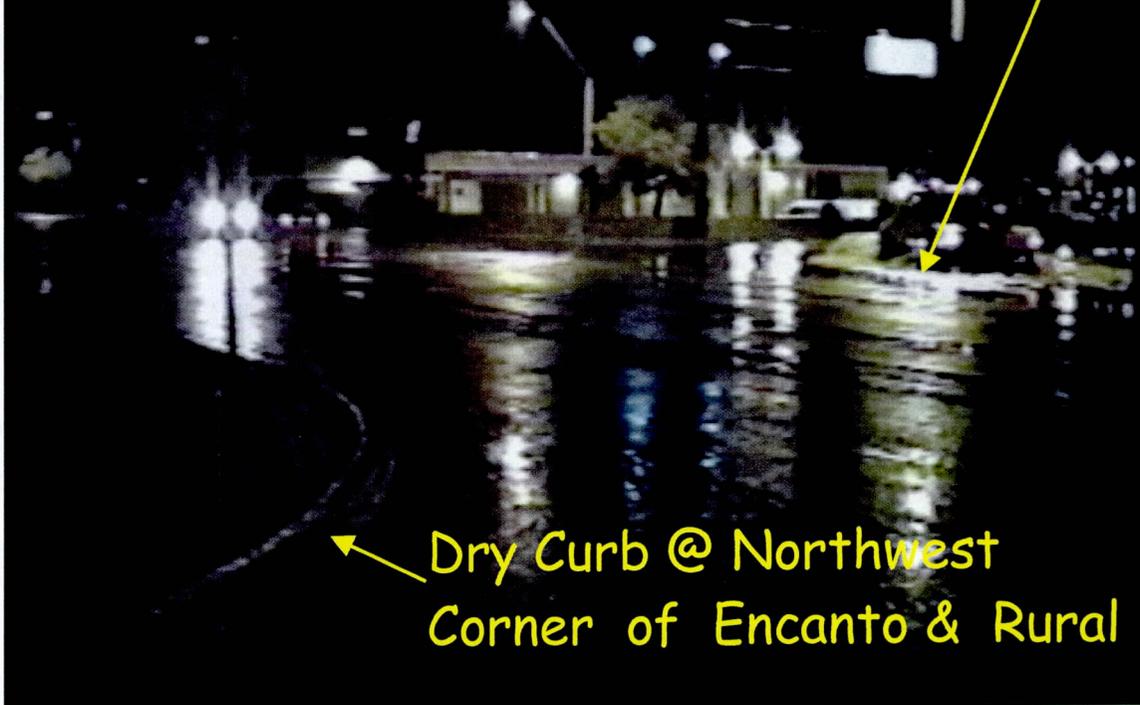
Curb Full Flow @ Southwest
Corner Encanto & Rural



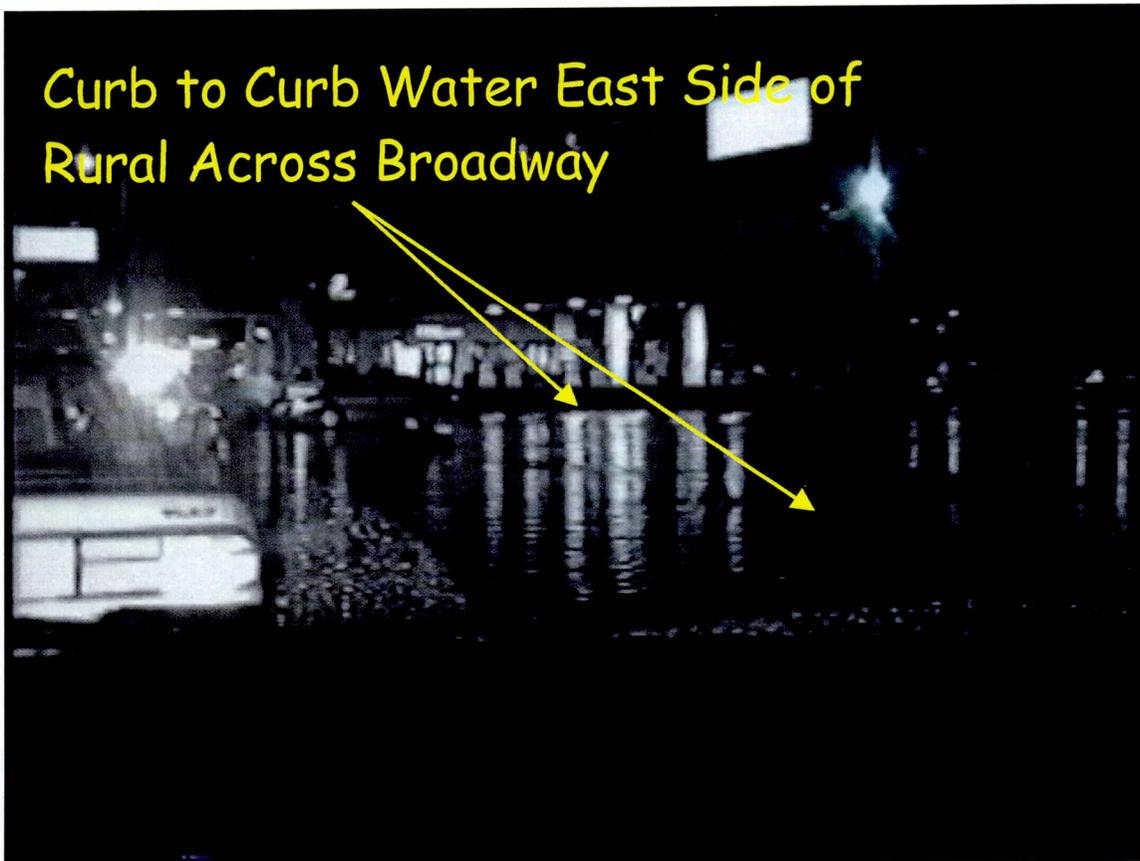
Flow Over Curb @ Southwest
Corner Encanto & Rural



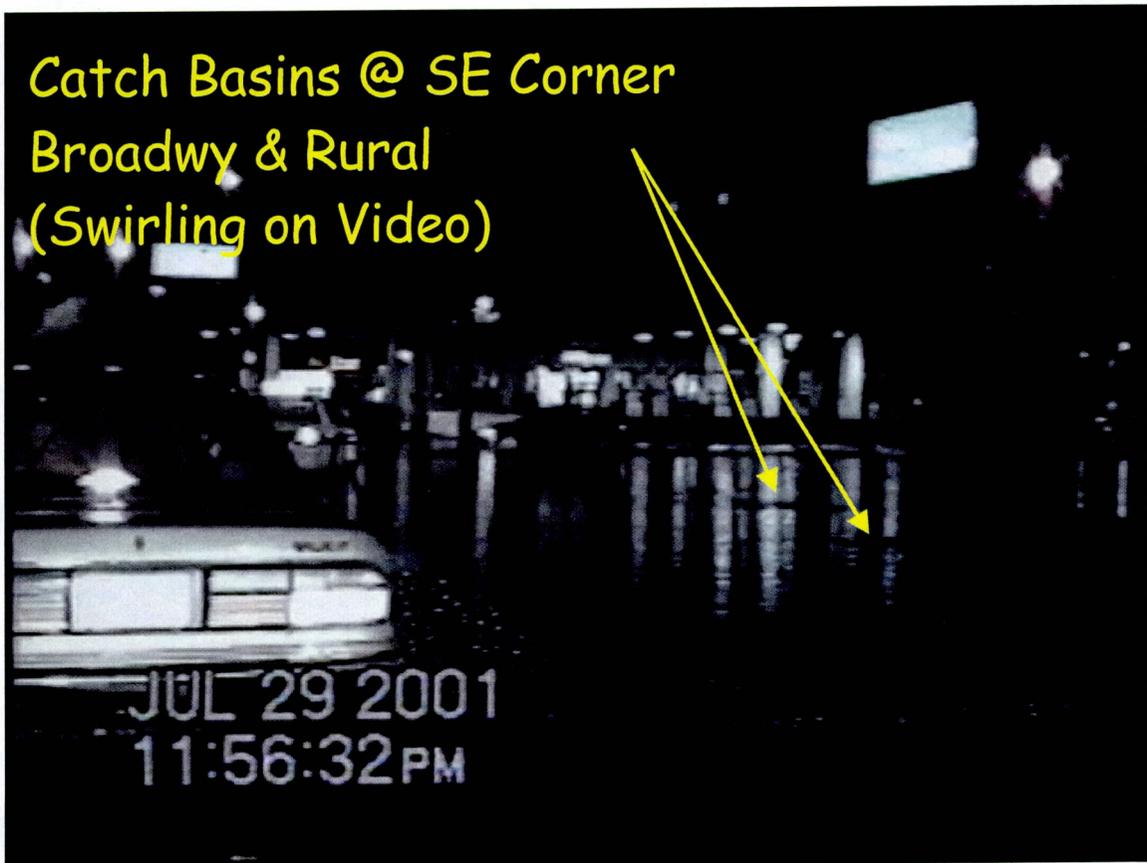
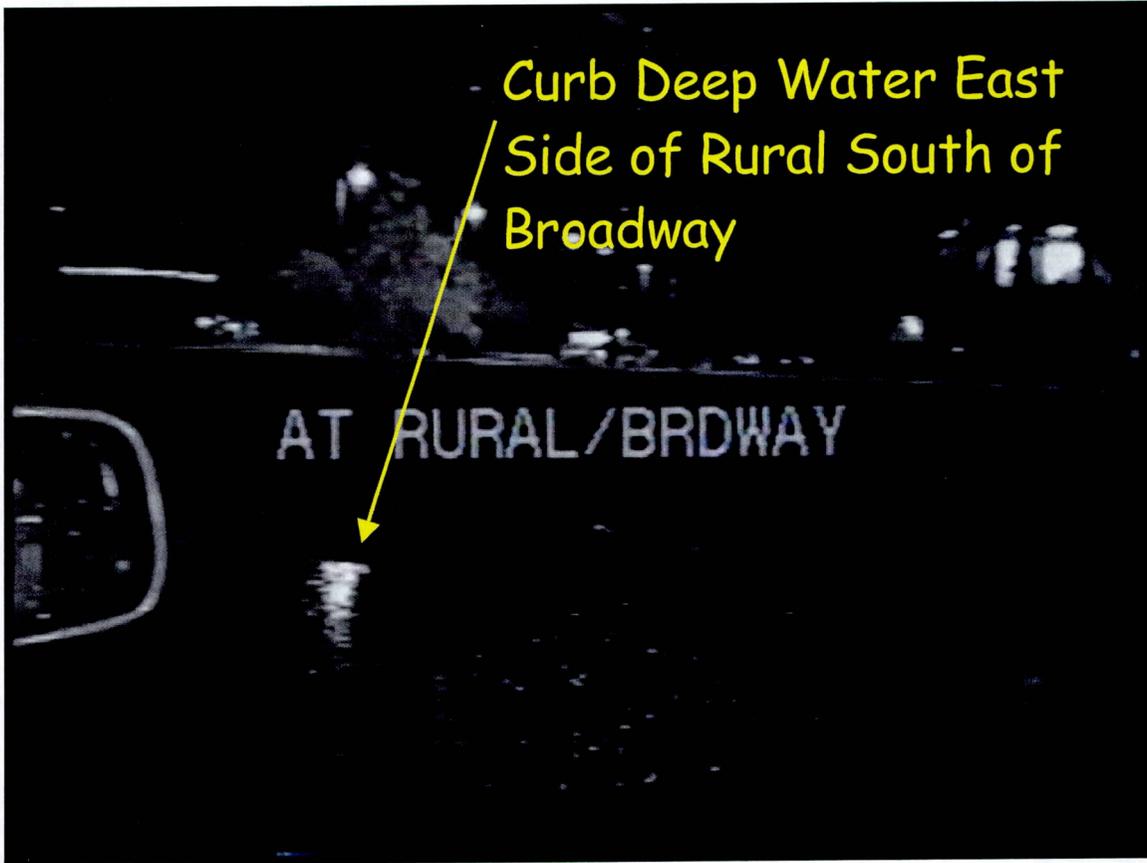
Curb Deep Water @ Southeast
Corner of Vista Del Cerro & Rural



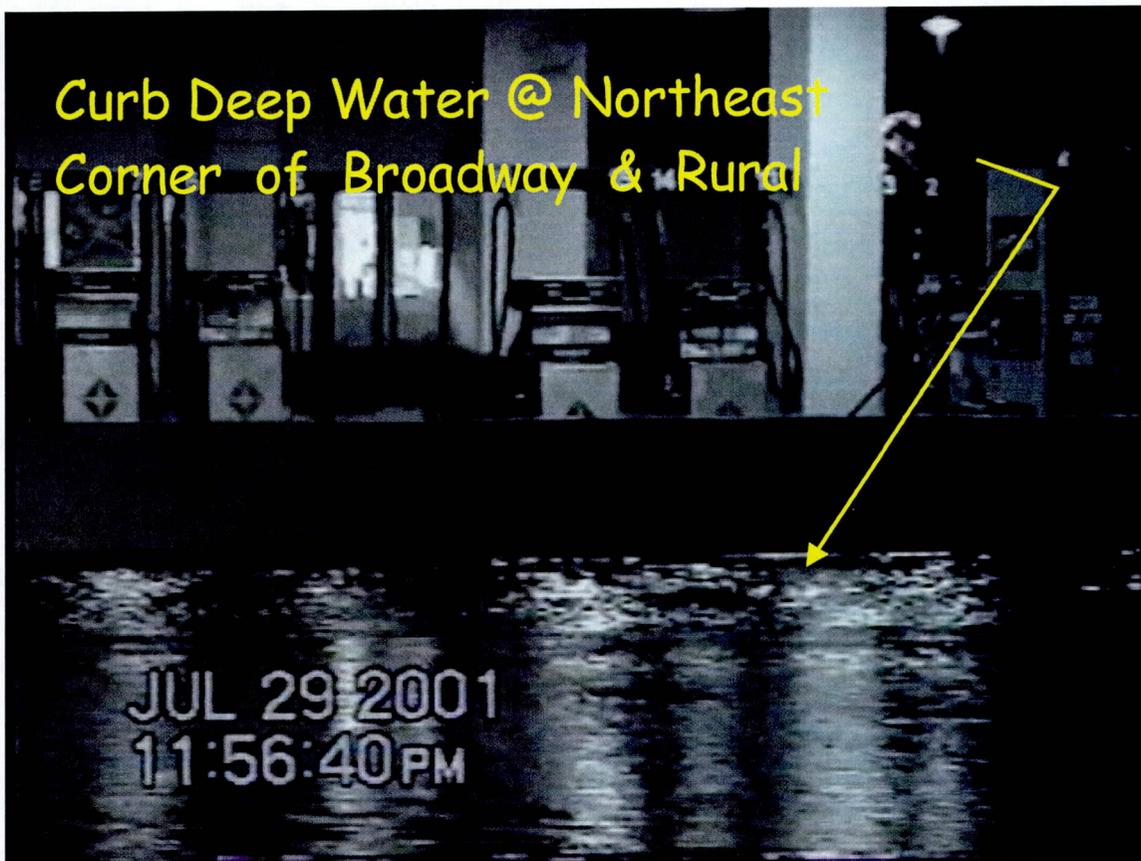
Dry Curb @ Northwest
Corner of Encanto & Rural



Curb to Curb Water East Side of
Rural Across Broadway

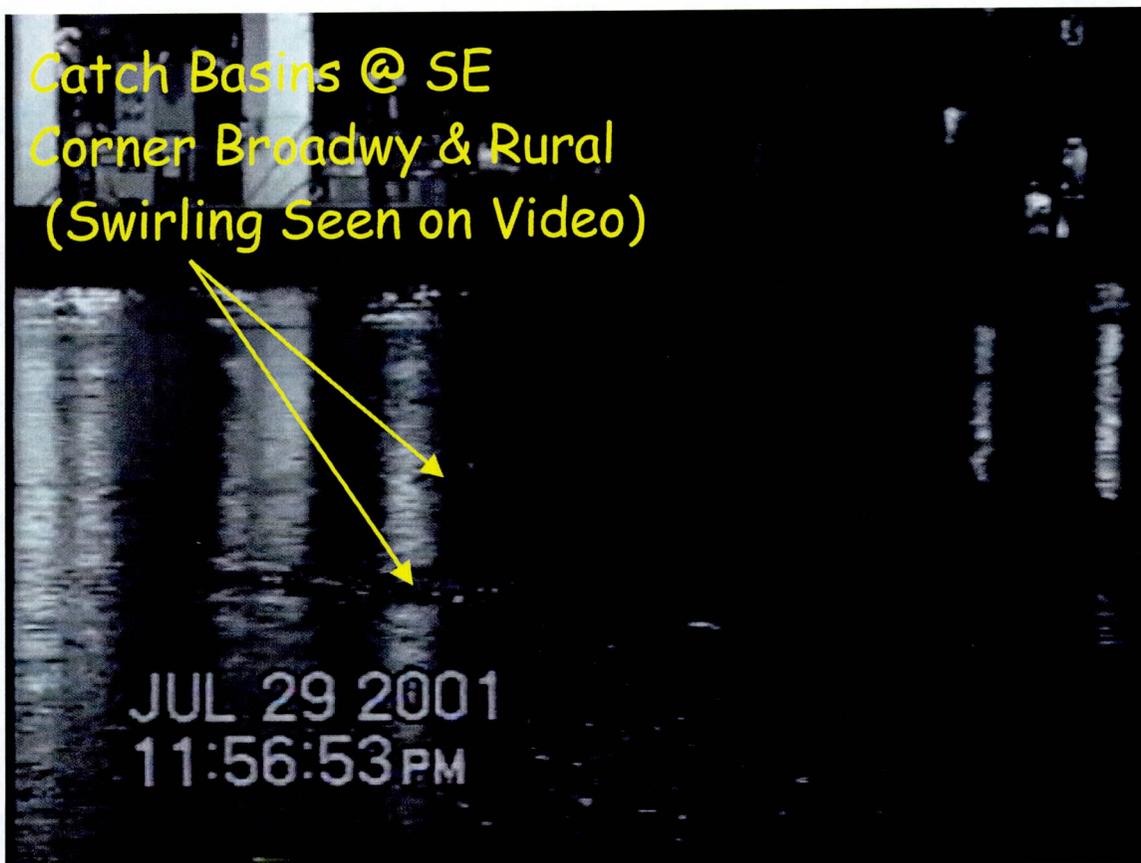


Curb Deep Water @ Northeast
Corner of Broadway & Rural



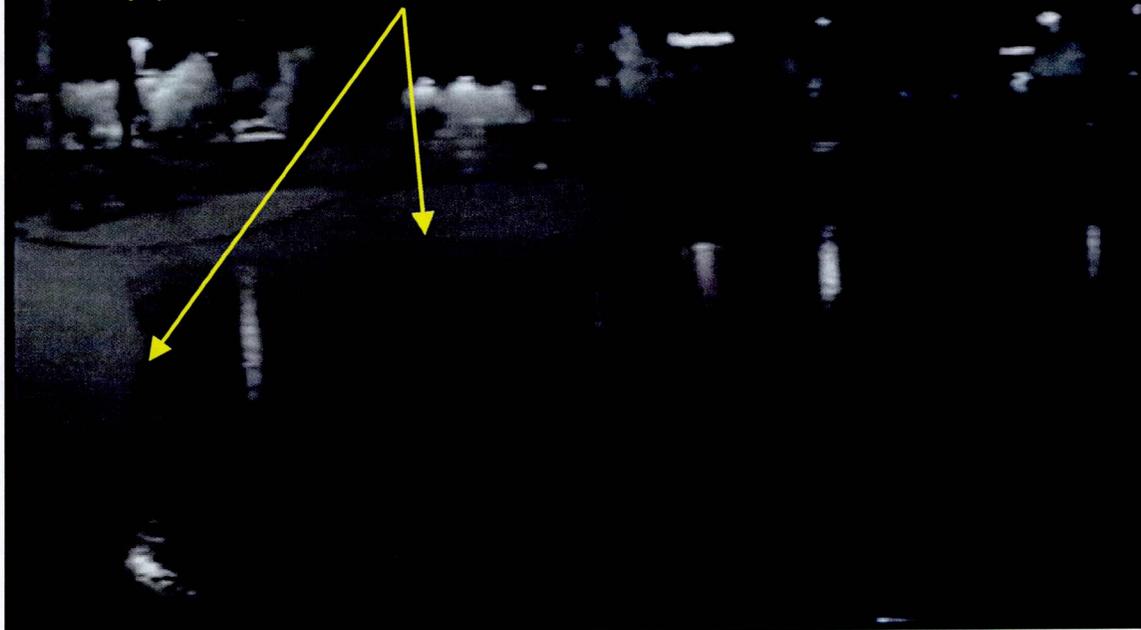
JUL 29 2001
11:56:40 PM

Catch Basins @ SE
Corner Broadway & Rural
(Swirling Seen on Video)



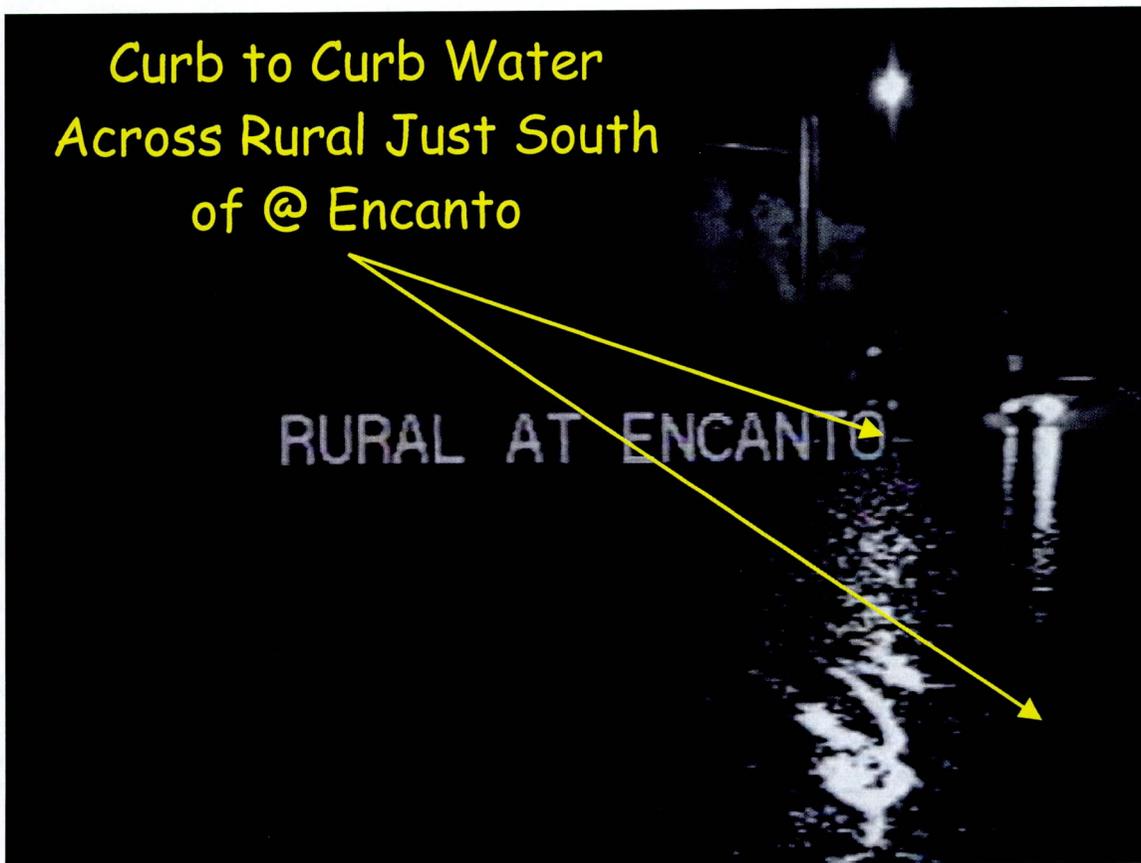
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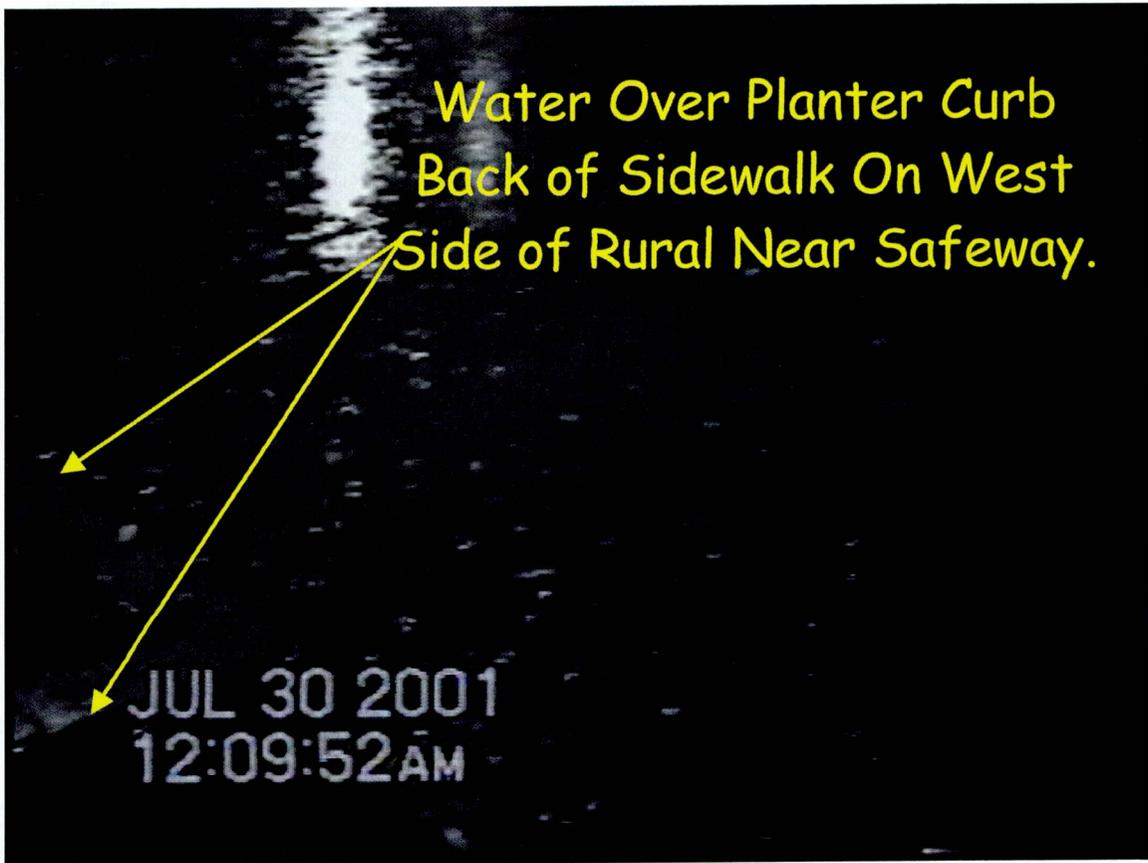
Detention Basin @ Safeway
(Approximately Half Full)



Curb to Curb Water
Across Rural Just South
of @ Encanto

RURAL AT ENCANTO



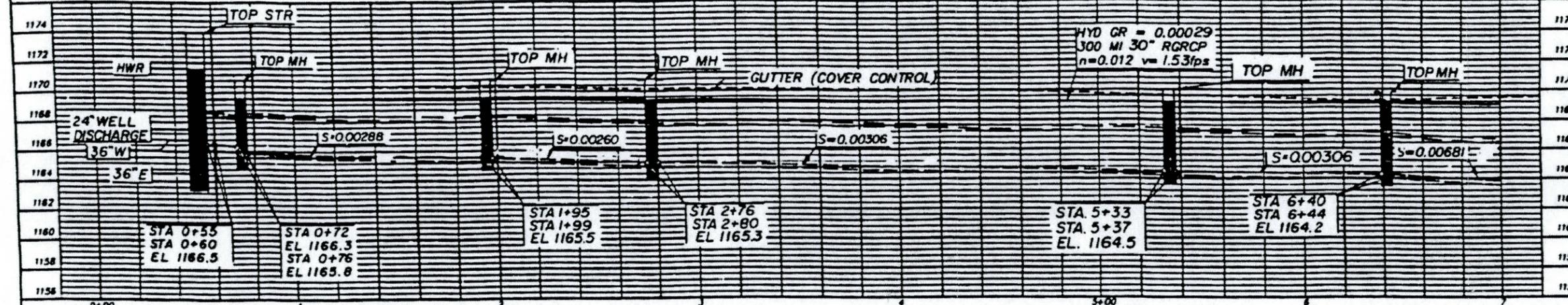
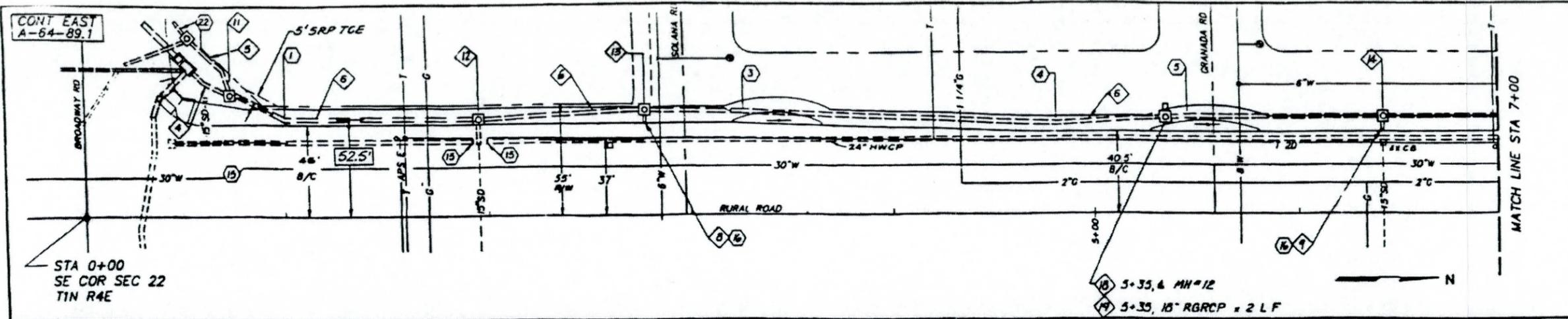


Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



APPENDIX B

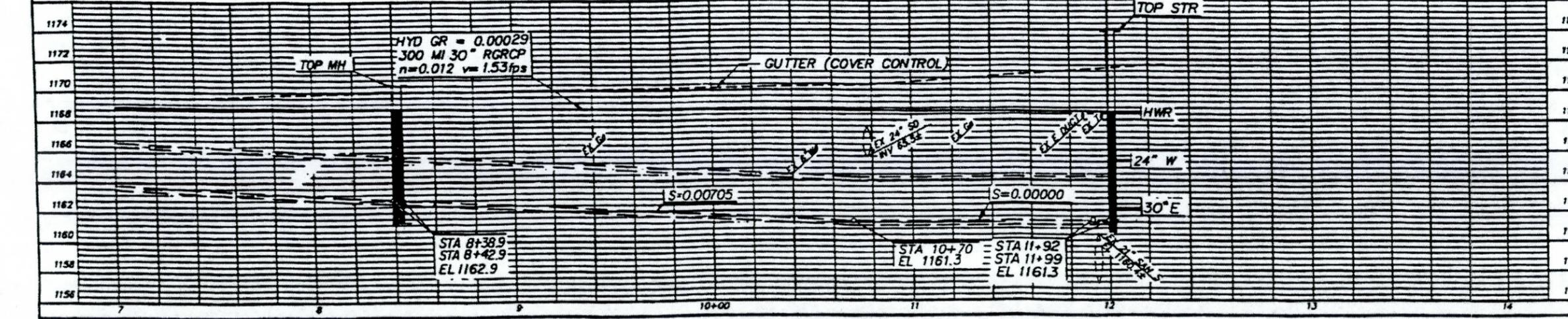
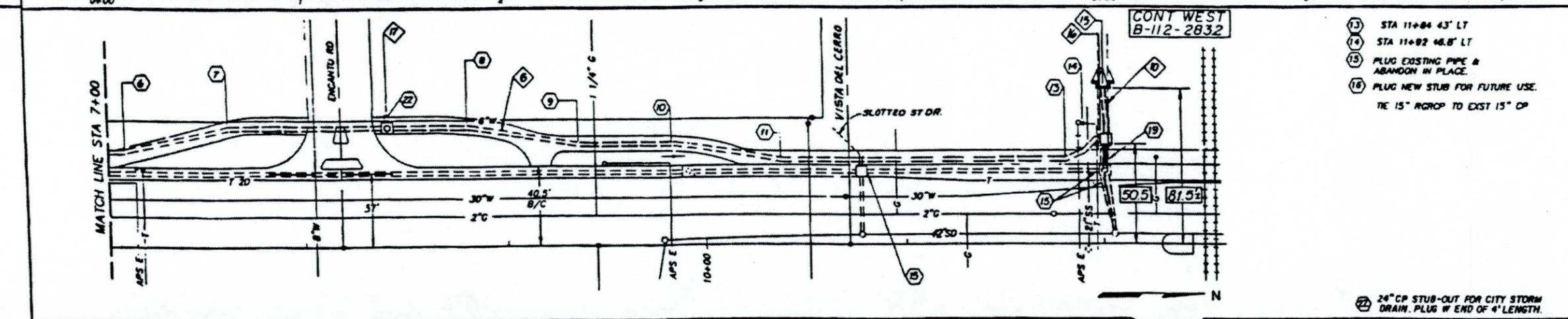


NEW IRRIGATION PIPE

NO	STA TO STA	SIZE X LF	TYPE
4	0+60 TO 0+72	24" X 16 LF	RGRCP
5	0+48 TO 0+74	24" X 40 LF	RGRCP
6	0+76 TO 11+99	30" X 1109 LF	RGRCP
8	2+78	18" X 2 LF	RGRCP
9	6+42	18" X 4 LF	RGRCP
10	12+01	24" X 1E LF	RGRCP

NEW IRRIGATION STRUCTURE

NO	STA	REMARKS
11	0+74 60.5' LT	E MH#9
12	1+97 52.5' LT	E MH#8
13	2+78 52.5' LT	E MH#7
14	6+42 48' LT	E MH#8
15	11+97±	MDM #1 CENTER IN EXST DITCH
16	11+98.5	MH T.O. DWG B-449-366
17	8+40.9	E MH#11
1	STA 0+94 52.5' LT	7) STA 7+62 60' LT
2	STA 3+26.7 51' LT	8) STA 8+80 80' LT
3	STA 4+80 44.5' LT	9) STA 9+33 51' LT
4	STA 5+48.2 48' LT	10) STA 9+84 51' LT
5	STA 7+08 48' LT	11) STA 10+38 43' LT



- 13) STA 11+84 43' LT
 - 14) STA 11+82 48.8' LT
 - 15) PLUG EXISTING PIPE & ABANDON IN PLACE.
 - 16) PLUG NEW STUB FOR FUTURE USE.
- THE 15" RGRCP TO EXST 15" CP

24" CP STUB-OUT FOR CITY STORM DRAIN. PLUG W END OF 4' LENGTH.

LOCATION PLAN

UNIVERSITY DR

RURAL RD

BROADWAY RD

ELEVATION EQUATION:
EL THIS DWG MINUS 0.06' EQUALS ELEV ON CITY OF TEMPE PLANS FOR PROJ NO 878181

STATION EQUATION:
STA 0+00 THIS DWG EQUALS STA 79+71.64 ON CITY OF TEMPE PLANS PROJ NO 878181

T.B.M. CUT "O" - W. END ISLAND CENTERLINE BROADWAY, W. OF RURAL EL 1172.45

RELOCATE MH #9, ADD MH #11 & 12

RD-71346 3/89 FCEC/FCEC

CONSTRUCTED FROM STA 0+00 TO STA. 14+00 FACILITIES MAY NOT BE EXACT.

RD-71346 7-90 SCB 54

PLOT SURVEY BOOK W- PAGE TO BY

REV	NO	JOB/LOG NO	DATE	DSGN ENGR	DTFR	CHKR	ENGR CHK	SURV APPD	ISSLE AUTH
0									

TEMPE CANAL
SALT RIVER PROJECT PHOENIX, ARIZONA

PUMP DITCH
SECT 22 T1N R4E

SE COR TO COR 16/7

SH.NO. 4

SCALE: PLAN 1"=30' PROFILE HOR 1"=30' VERT. 1"=4'

SUBJ CODE EXSTR CODE DWG SIZE

PP Y-2X1 22 X 34 B-112-634

Candidate Assessment Report: Rural & Broadway

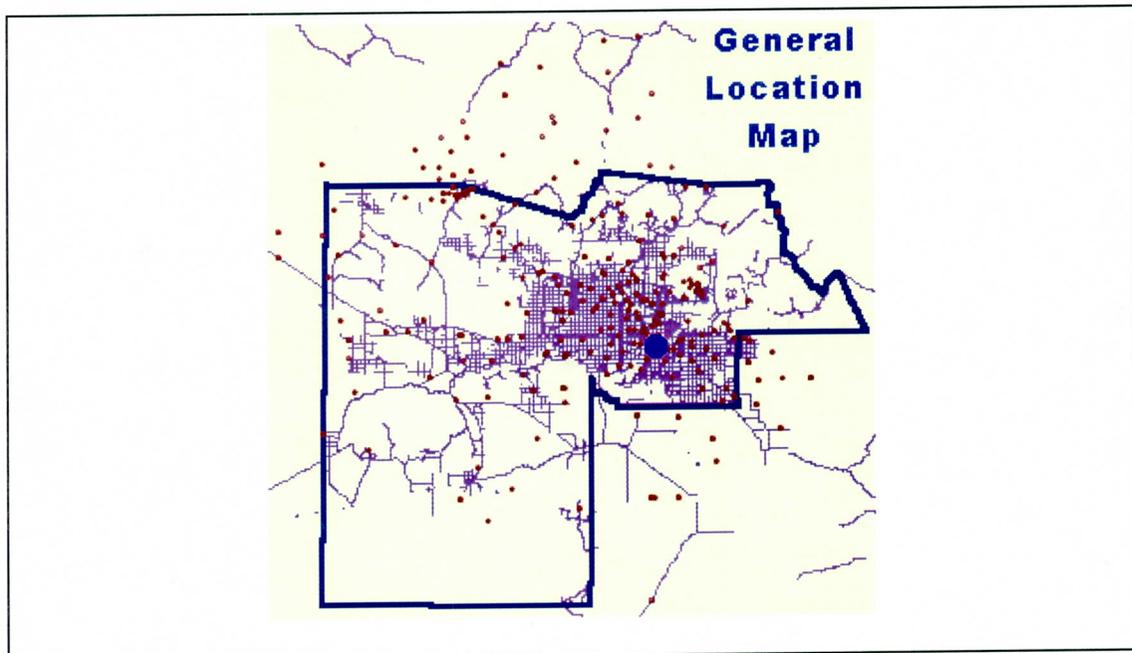
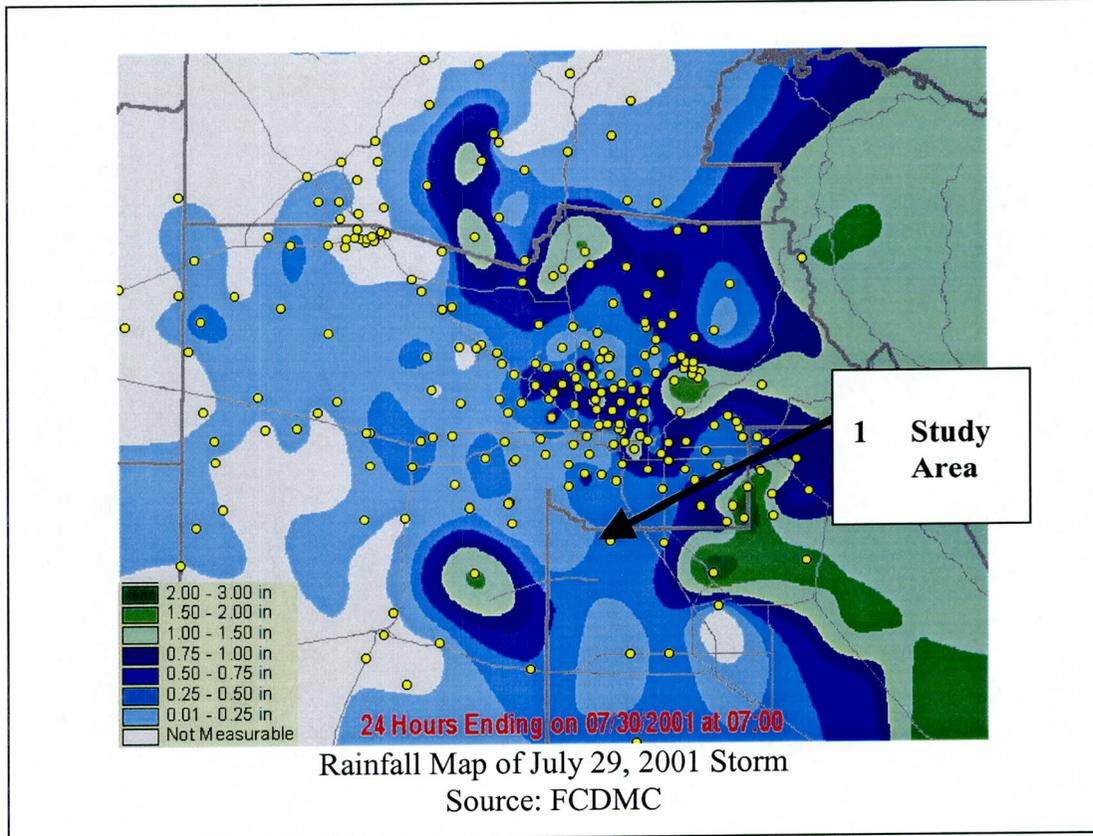
Flood Control District of Maricopa County, Arizona...



APPENDIX C

Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



Station Name: ASU South

Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



Station ID Number History:	4525 since 7/14/95
Data Begins:	7/14/95
Years of Record:	6.22 (as of 10/1/01)
Data Repeater:	Direct
TRS:	T1N-R4E-Section 22
Latitude:	33 24' 45"
Longitude:	111 55' 51"
Elevation:	1,160 ft.
Location:	1/4 mi. NNE of Broadway Rd. and Mill Ave.
Data Record:	
Partial Months (>10 days missing):	None
Missing Months:	None
Remarks:	Records good

Data Statistics for Period of Record:

Number of storms greater than 1 inch in 24 hours:	6
Number of storms greater than 2 inches in 24 hours:	0
Number of storms greater than 3 inches in 24 hours:	0
Greatest 15 minute total:	0.83 on 09/28/95
Greatest 1 hour total:	1.22 on 08/18/96
Greatest 3 hour total:	1.30 on 07/29/01
Greatest 6 hour total:	1.34 on 08/18/96
Greatest 24 hour total:	1.89 on 03/06/00

Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



Water Year Totals: (Mean of Complete Water Years [6] = 7.24 inches)

Water Year	Total	Water Year	Total
2010		2000	3.82
2009		1999	7.68
2008		1998	10.35
2007		1997	5.39
2006		1996	6.10
2005		1995	M
2004		1994	
2003		1993	
2002		1992	
2001	10.08	1991	

M: One or more months contain partial or missing data

Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



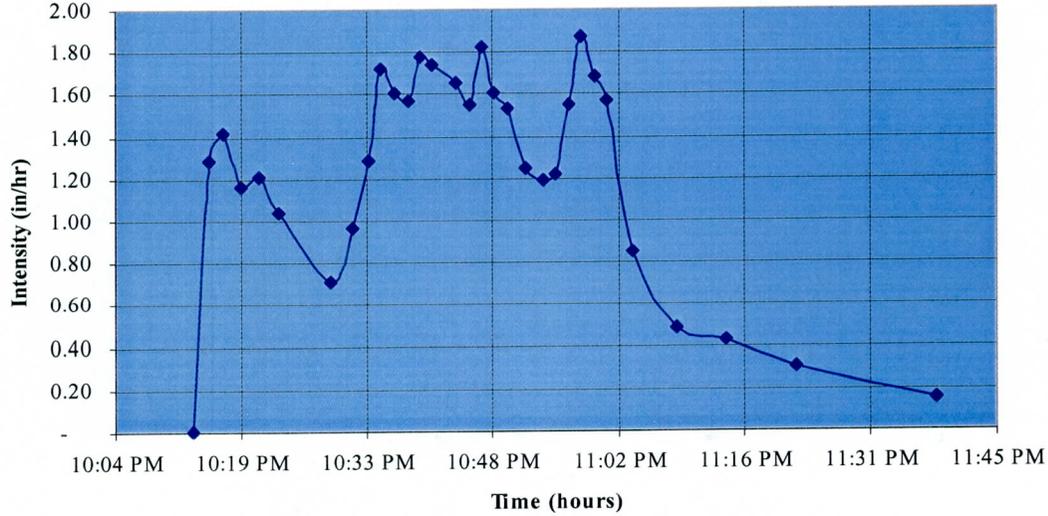
Date	Clock Time	Differential Time (hours)	Elapsed Time (hours)	Gauge Total (inches)	Storm Totals (inches)	Delt (inches)
7/31/2001	14:04:19	12:00:07		9.57	0.00	0.00
7/31/2001	2:04:12	11:59:54		9.57	0.00	0.00
7/30/2001	14:04:06	10:51:48		9.57	0.00	0.00
7/30/2001	3:12:18	1:08:19		9.57	0.04	0.04
7/30/2001	2:03:59	1:49:26		9.53	0.00	0.00
7/30/2001	0:14:33	23:24:16	23.4044	9.53	1.34	0.04
7/29/2001	23:38:49	0:16:03	0.2675	9.49	1.30	0.04
7/29/2001	23:22:46	0:07:58	0.1328	9.45	1.26	0.04
7/29/2001	23:14:48	0:05:43	0.0952	9.41	1.22	0.04
7/29/2001	23:09:05	0:05:05	0.0833	9.37	1.18	0.04
7/29/2001	23:04:00	0:02:49	0.0469	9.33	1.14	0.04
7/29/2001	23:01:11	0:01:32	0.0256	9.29	1.10	0.04
7/29/2001	22:59:39	0:01:35	0.0239	9.25	1.06	0.04
7/29/2001	22:58:04	0:01:17	0.0214	9.21	1.02	0.04
7/29/2001	22:56:47	0:01:33	0.0258	9.17	0.98	0.04
7/29/2001	22:55:14	0:01:29	0.0247	9.13	0.94	0.03
7/29/2001	22:53:45	0:02:01	0.0336	9.09	0.91	0.04
7/29/2001	22:51:44	0:01:56	0.0322	9.06	0.87	0.04
7/29/2001	22:49:48	0:01:34	0.0261	9.02	0.83	0.04
7/29/2001	22:48:14	0:01:30	0.0250	8.98	0.79	0.04
7/29/2001	22:46:44	0:01:19	0.0219	8.94	0.75	0.04
7/29/2001	22:45:25	0:01:33	0.0258	8.90	0.71	0.04
7/29/2001	22:43:52	0:02:54	0.0483	8.86	0.67	0.08
7/29/2001	22:40:58	0:01:23	0.0231	8.78	0.59	0.04
7/29/2001	22:39:35	0:01:21	0.0225	8.74	0.55	0.04
7/29/2001	22:38:14	0:01:32	0.0256	8.70	0.51	0.04
7/29/2001	22:36:42	0:01:30	0.0250	8.66	0.47	0.04
7/29/2001	22:35:12	0:01:24	0.0233	8.62	0.43	0.04
7/29/2001	22:33:48	0:01:52	0.0311	8.58	0.39	0.04
7/29/2001	22:31:56	0:02:30	0.0417	8.54	0.35	0.04
7/29/2001	22:29:26	0:05:54	0.0983	8.50	0.31	0.07
7/29/2001	22:23:32	0:02:19	0.0386	8.43	0.24	0.04
7/29/2001	22:21:13	0:01:59	0.0331	8.39	0.20	0.04
7/29/2001	22:19:14	0:02:04	0.0344	8.35	0.16	0.04
7/29/2001	22:17:10	0:01:42	0.0283	8.31	0.12	0.04
7/29/2001	22:15:28	0:01:52	0.0311	8.27	0.08	0.04
7/29/2001	22:13:36	18:20:36	18.3433	8.23	0.04	0.04
7/29/2001	3:53:00	1:49:14		8.19	0.00	0.00
7/29/2001	2:03:46	11:59:53		8.19	0.00	0.00
7/28/2001	14:03:39	12:00:06		8.19	0.00	0.00
7/28/2001	2:03:33	2:03:33		8.19	0.00	0.00

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Flood Control District of Maricopa County, Arizona...



Intensity of 7/29/02 Storm



Drainage Design Management System - 0001

File Edit Hydrology Hydraulics GIS Utilities Help Window

Rainfall Data

Project ID: 0001

Location: Primary Zone: 7, Short Duration Zone: 8

Point Values (in): 2-Year, 100-Year, 6-Hour, 24-Hour

Duration	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
5 MIN	0.30	0.41	0.48	0.58	0.66	0.74	0.93
10 MIN	0.44	0.62	0.73	0.89	1.02	1.14	1.42
15 MIN	0.54	0.77	0.92	1.14	1.30	1.46	1.84
30 MIN	0.72	1.03	1.25	1.53	1.76	1.98	2.49
1 HOUR	0.87	1.28	1.55	1.91	2.20	2.48	3.13
2 HOUR	0.97	1.41	1.70	2.10	2.42	2.72	3.43
3 HOUR	1.03	1.50	1.81	2.23	2.56	2.89	3.64
6 HOUR	1.15	1.67	2.01	2.48	2.84	3.20	4.03
12 HOUR	1.28	1.85	2.23	2.75	3.15	3.55	4.47
24 HOUR	1.41	2.04	2.45	3.02	3.46	3.90	4.91

Approximate July 29, 2001 Storm

NUM 3:38:50 pm

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Flood Control District of Maricopa County, Arizona...



Application

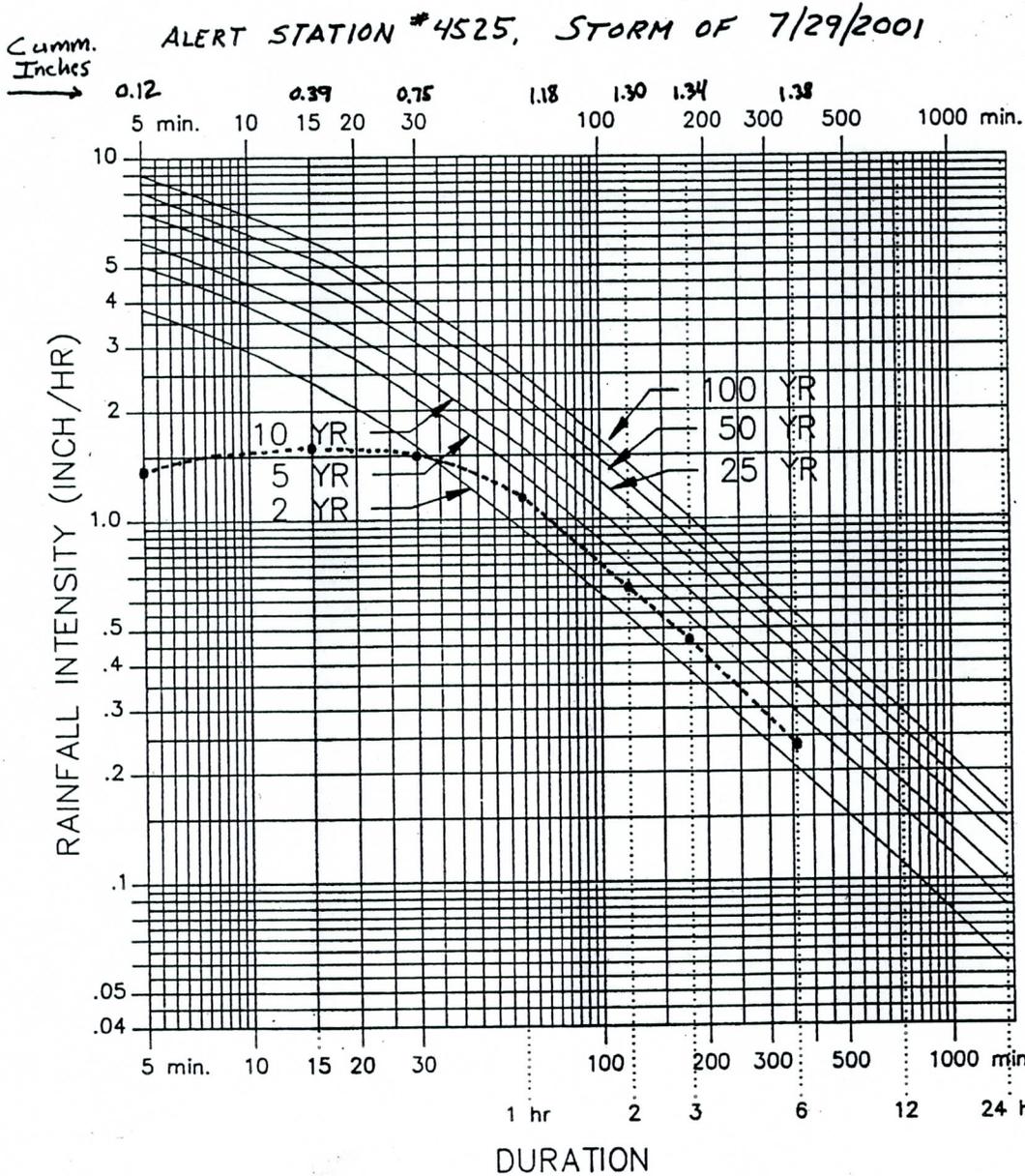


Figure 3.2
Rainfall Intensity-Duration-Frequency Relation
(Phoenix Metro Area)

9/20/02
SDW

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APPENDIX D

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Flood Control District of Maricopa County, Arizona...



DRAINAGE REQUIREMENTS

In accordance with Ordinance No. 819.1 adopted by the Tempe City Council on April 21, 1977 and Ordinance No. 93.03, adopted February 11, 1993, the following criteria are established to provide proper measures for handling and disposal of storm water runoff. Requirements for specific development (subdivision, offsite) will be determined by the applicable criteria.

A. HYDROLOGY REPORTS

Flows (Q's) should be calculated for the 100 year storm according to the methods outlined in the Hydrologic Design Manual published by the Maricopa County Flood Control District. The rational method may be used for areas of 160 acres or less. At the option of the Engineer, the Maricopa County Flood Control District Hydraulic Design Manual may be used to determine required retention volumes.

1. Subdivisions

Preliminary hydrology report must be submitted with the preliminary subdivision plat. A contour map will be required with the report showing the existing drainage of the property (channels, ditches, structures, overland flow, etc.), including any drainage crossing the property from upstream areas. Another map shall show the proposed subdivisions runoff Q's, points of concentration, limits of each drainage area, location and size of storm sewers and catch basins. For retention, show volume of water required to be stored, location of storage, and method of disposal. A final hydrology report must be provided before construction plans will be reviewed. The report will show:

- a. A complete runoff analysis in tabular form.
- b. Points of concentration with peak street flows and drainage areas.
- c. Calculation for sizing catch basins, pipe, and locating catch basins.
- d. Retention basin characteristics.
 - I. Inlet structure.
 - II. Detailed calculation of volume required and actual holding volume.
 - III. Calculation and verification for disposing of water within thirty-six (36) hours.
- e. Calculations of 100-year runoff at critical points of subdivisions (low points/constrictions to overland relief).
- f. Maximum elevation difference shall be 1' between adjacent residential finished floors not separated by a street.

2. Commercial and Industrial

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For developments not requiring a subdivision map, such as a lot, tract, or individual parcel the Hydrology and Retention Volume calculations shall be put on a "Grading & Drainage Plan". The plan and calculations must contain the following:

a. Hydrology and Retention calculations for a one hundred year storm including:

I. Volume required

II. Volume retained

b. General Notes for Grading and Drainage.

c. Easily identified retention areas, fully dimensioned with high water elevation called out. The lot outfall is to be .30' above design high water elevation. (Section views as required for clarity).

d. Retention Basin Volume calculations easily verified and shown by basin.

e. When paved areas are incorporated into lot retention, water depth is not to exceed 1.0'.

f. Finish floor elevation is to be a minimum of 12" above the highwater design and 8" above the lot outfall.

g. Some acceptable method of dissipating storm water within a 36-hour period. If a drywell is to be used, the drywell volume can be included in the calculations for volume provided. A drywell is required for dissipation whenever paved areas or basins greater than 1.0' in depth are incorporated into retention. No allowances for volume due to percolation rate will be given. See Section IV (D) for drywell limitations. Retention areas at locations involved in fuel dispensing shall use Envibro Drywells or equal.

h. Drywells must penetrate a minimum of 10' into suitable permeable strata.

I. Drywell grates shall be 0.5' above basin bottoms.

i. Drywells must be registered with the Arizona State Department of Environmental Quality. An Aquifer Protection Permit (APP) may also be required.

B. STREET AND STORM DRAIN DESIGN

1. The Maricopa County Flood Control District Hydrologic Design Manual or the Rational Method using the charts and nomographs in this section (Figures I-III) for determining peak runoff for subdivisions shall be used.

Note: A composite C value is to be used for storm drain design purposes only. Required retention volume is calculated in accordance with Section IV, Retention Design Criteria.

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2. Rainfall intensity is related to time of concentration. Time of concentration is the summation of Overland Flow Time, Street Time and Pipe Time.

a. Overland Flow Time is that time required for a drop of water falling on an open area (lawn, field, etc.) to reach an outlet point (street, ditch, pipe, etc.) Smaller lots, larger building footprints, and increasing non-pervious services (roots, driveway, patio, etc.) require overland travel time of 10 minutes maximum.

b. Street Time is that time required for the runoff to travel from entrance onto the street to entrance into a catch basin, drainage channel (or to some other point along the street where the runoff exits from the street).

c. Pipe Time is that time required for the runoff to travel in the pipe from the entrance catch basin to another point along the storm drain - usually an entrance structure for another drainage area, retention basin, drainage channel, etc.

The time of concentration shall be arrived at in the following sequence:

I. Overland Flow Time refer to paragraph II.B.1 and Figure 1.

II. Street Time is computed by dividing the length of street flow by the runoff velocity when flowing at top of curb. Velocity shall be computed using Manning's equation with $n = .015$.

III. Pipe and channel flow shall be computed using the velocity occurring at design flow in a pipe or channel of given size and material. Velocity shall be computed using Manning's equation with the "n" value for pipe of 0.012.

Refer to any published table of values for "n" values of channels.

C. DESIGN STORM:

Streets, catch basins and storm sewers shall be designed for a ten-year storm. When the computed runoff exceeds the capacity of a street (where the depth of flow is at the top of curb) subsurface drainage will be required. Note: The most common error is the overloading of one side of a street where the majority of runoff is placed on one side of the street and the capacity is considered for both sides. Valley gutters will not be permitted across midsection collector streets or arterial streets. 4" roll curb is required in single family residential development. Valley gutters will be discouraged on other collector streets. Peak flows from a 100-year storm must be carried within the cross section between buildings (front yards and streets).

Storm drains shall be designed to provide the required capacity without surcharging the line. Storm drain outlets shall be designed to function as a part of the ultimate drainage system.

Effective drainage will be permitted during the interim of development and construction of a completed storm drain system. Storm sewers shall not be designed with less than a velocity of 3 fps. No pipe shall be less than 18" in diameter. When a pipe size has been established, it shall not be reduced, unless for a metered situation. Maximum manhole

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spacing for 36" pipe or less is 600' and above 36" is 800'. Manholes will be required at a change of grade, change of pipe size, or alignment. Curved pipe will not be permitted for 36" pipe or less. Catch basins shall be designed to intercept a minimum of 80% of the total runoff delivered to the point in the street where depth of street flow reaches curb height. Sump catch basins shall be designed to receive all of the runoff at the catch basin. In situations where catch basins are sumped, the Engineer will verify that overland relief for the 100-year storm is available without damage to buildings. Catch basin capacities shall be determined from Hydraulic Engineering Circular No. 12 (HEC-12) published by the Federal Highway Administration or the Maricopa County flood Control District Hydraulic Design Manual. No grate type catch basins are permitted. Length of curb opening shall be 5.5' minimum. Slotted drain with angled slots (minimum length - 10') may be used in combination with catch basins.

D. Retention Design Criteria

1. Retention onsite of the 100-year 1-hour storm is required.

2. Method of Storage

a. Individual lot storage shall consist of providing adequate storage volume for the lot, plot or parcel of land using method in part IV C.1. Storage volume shall include adjacent streets and alleys except for arterial streets. Although Ordinance 819.1 allows a maximum depression of 8" for single family lots, experience with depressed lot construction and maintenance shows that normal rounding of typical confined yard depressions results in an average of 6" throughout the basin bottom area.

Therefore, the maximum allowable depth of water for calculation of retention volume provided for single family residential lots will be 6", even though the plans specify depth of 8". Subdivisions of less than 18,000 sq.ft. lot (single family zoning) will be required to utilize combination storage. The perimeter and house-footing berm configurations shall be submitted with the final hydrology to substantiate the retention volume provided (Fig. III) - Individual storage over 1.0' in depth will require a disposal mechanism to meet the 36 hr. criteria.

b. Central storage shall provide adequate volume to handle the 100-year, 1-hour storm runoff from the property being developed. In the case where the central basin will remain as private ownership, it will be required that such property be set aside for drainage purposes per easement, see Figure IV. All maintenance and operation shall be the responsibility of the owner of the property. In the case where the central storage will be dedicated to the City for public use, an easement for the drainage area will be required. (Figure V)

The City may require the owner to comply with the following conditions:

- I. Construction of drywells as necessary to dispose of nuisance water.
- II. Seeding to provide ground cover.
- III. Construction of flood irrigation and/or sprinkler systems.

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IV. Other construction as the City may deem necessary to the proper public use of the property.

Upon acceptance of the dedication and the completion of the required construction, the City will assume responsibility for operation and maintenance. Design of such storage is outlined in the following section (D-3).

c. Combination storage shall consist of providing retention on individual lots and the balance of the 100 year, 1 hour storm (2.4 inches) within a central storage area. See subsection IV. B.1. for onsite retention and the above subsection (D.2.6) and following section (IV. C.) for central storage. The "C" factor is the non-absorption factor of (.95) on the onsite lot area and the run-off factor for the right-of-way water contributing to the central storage.

I. Where a residential subdivision is designed using combination storage, the entire volume of water generated minus the amount held by the depressed lots is the amount of central storage required.

II. Rear yard retention will only be allowed on lots of 6500 square feet or greater. Rear yard retention is difficult to surveil after occupancy and experience has shown that spas, pools, patios, gazebos, garages, storage buildings and other amenities regularly usurp original depressed on lot storage. Therefore a "coefficient of build-out" will be applied to the proposed retention volume to reduce it to 40% of the original rear yard retention volume.

III. Finish floor elevations for single family residences to be a minimum of 14" above outfall of lot per Figure III.

3. The design of the central storage retention facility shall conform to the following:

(Engineers, may at their option, use the MCFCD Hydrology Design Manual to determine required retention volumes. When the MCFCD Manuals are used for retention volume calculations, note that the 100 year, 2 hour storm is used along with variable "C" factors. Standard City of Tempe freeboard requirements shall still apply.)

a. Determine volume:

$$V = \frac{D}{C}AC$$

12

V = volume (ft)

A = area (ft), total area of development excluding arterial right-of-way only

D = depth of water required to retain (2.4 inches)

C = retention non-absorption coefficient (.95)

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- b. All central storage basins must drain towards outlet.
- c. The typical maximum side slope is 4:1; City parks require flat bottoms (irrigation) & 10:1 side slopes. Private retention basins utilized for recreation require maximum 5:1 side slopes. Minimum bottom grade is 1%, except at City parks.
- d. Maximum depth of water in central storage basins shall be 3'
- e. Retention areas shall not occupy more than 67% of the onsite landscaped street frontage areas.
- f. In the Rio Salado Overlay District and the Southwest Overlay District, the first 10' of onsite street frontage landscaping shall not be used for retention purposes (use 5:1 slopes maximum for residential and recreational purposes, use 4:1 for industrial areas).
- g. Provide a minimum of 1' freeboard above the high water design elevation on all sides of the retention area, including lowest development gutter flow line.
- h. Wherever possible, overland relief must be provided.
- i. Discharge requirements:
 - I. Retention volume must be disposed of in 36 hours.
 - II. Basins greater than 1' in depth will require a drywell or other approved disposal mechanism.
 - III. Basins less than 1' in depth may require a drywell or other approved disposal mechanism.
- j. Drywells will be permitted, pending approval by State Dept. of Environmental Quality, for disposal of water, however, no percolation rate will be considered for reduction of retention volume.
- k. Invert of inlet pipe shall not be lower than bottom of retention facility at point of entrance unless otherwise approved.
- l. Inlet and outlet structures shall have a 6' wide concrete apron at the opening and shall be constructed to prevent easy access (children).
- m. When the Maricopa County Flood Control District Hydrology and Hydraulic Design Manuals are used for retention volume calculations, note that the 100 year-2 hour storm is used along with variable "C" factors. Standard City of Tempe freeboard requirements still apply.

4. NPDES (National Pollutant Discharge Elimination System) regulations require the City of Tempe to promulgate a storm water management system that regulates quality as well as quantity. The statute is Section 402(p) of the Water Quality Act of 1987. In August 1998, the City Council adopted amendments to Chapter 12 of the Tempe City Code by adding Article VI.

Drainage plans shall implement the following design parameters.

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- a. No drywells allowed in paved areas.
- b. No direct connections allowed to drywells.
- c. No drywells or other outlets allowed in truckwells.
- d. Truckwells shall not be designed to accept flow from other areas of the site. Provide sump pump with manual switch for draining truck wells.
- e. Generally, retention basins shall have grass bottoms, unless otherwise approved on Engineering drawings. Turfed basins greater than one foot in depth will require a single chamber drywell similar to the Maxwell IV. If a surface treatment other than turf is used, regardless of the depth, a 2-chambered drywell system similar to the Maxwell Plus System will be required. Retention areas 1 ft. deep or less with no grass in the bottom in commercial/industrial developments require drywell access.
- f. No direct connections from catch basins/pipes to drywells.
- g. No subsurface retention facilities allowed.
- h. Interceptors for commercial/industrial/multi-family developments may be required to filter and treat runoff.
- i. The City wants to reduce water uses where-ever possible.
- j. If turf landscaping is not provided in commercial or industrial sites, special two-chambered mechanical filtering drywell mechanisms (Maxwell Plus or equal) shall be used.
- k. The above surface retention requirements avoids unnecessary "out of site-out of mind" maintenance/monitoring requirements to avoid groundwater contamination in the future.
- l. In the Southwest Tempe Overlay District or the Rio Salado Overlay District, the first 10' onsite street frontage landscaping shall not be used for retention purposes.
- m. Retention areas shall not occupy more than 67% of the on-site street frontage landscape area.
- n. All retention areas shall maintain slopes no steeper than 4:1.
- o. All on-site water retention areas, other than paved surfaces shall be entirely landscaped.
- p. The City does not allow underground storm water retention without the specific written approval of the City Engineer.



Ordinances, Policies and Notes Regarding Drainage in Tempe

ON-SITE DRAINAGE PLAN NOTES

1. A Public Works permit issued by the Engineering Division shall be required for the onsite drainage of the project.
2. Prior to acceptance the owner/developer shall furnish the following:
 - a. Drilling log and certification of compliance for all dry wells.
 - b. A 3 mil. reproducible mylar copy of the approved plans with this certification signed by a registered professional engineer:
3. "This is to certify that an actual field survey was made under my supervision of the subject site and that finish floor and retention elevations are the true "As-Built" conditions, and they meet or exceed the original retention requirements as shown on this approved plan."
4. Underground storm water storage systems, when used and specifically approved in writing by the City Engineer, shall be the sole responsibility of the owner, including the design, construction, inspection, monitoring and maintenance. The owner shall be liable for any and all claims resulting there from. The City of Tempe, by allowing this system assumes no liability or responsibility for the design, construction, inspection, monitoring, and/or maintenance of the system. A deed restriction describing the system shall be recorded. This document shall state that the deed restriction cannot be relinquished or abandoned without the written approval of the City of Tempe.

ARTICLE III. SUBDIVISION DESIGN PRINCIPLES AND STANDARDS

Sec. 30-20. General.

- (a) Every subdivision shall conform to the requirements and objectives of the general plan, or any parts thereof, as adopted by the commission and the city council, to the zoning ordinance and to other ordinances and regulations of the city, and to the Arizona Revised Statutes.
- (b) Where the tract to be subdivided contains all or any part of the site of a park, school, **flood control facility**, or other public area as shown on the general plan or as recommended by the commission, such site should be dedicated to the public or reserved for acquisition by the public within a specified period of time. An agreement should be reached between the subdivider and the appropriate public agency regarding time, method and cost of such acquisition. In the event the commission determines that such an agreement has not been reached within a reasonable period of time, then the commission may make a determination that the requirements of this section have been met.
- (c) **Land which is subject to periodic flooding, land which cannot be properly drained, or other land which, in the opinion of the city, is unsuitable for any use shall not be subdivided; except that the city may approve subdivision of such land upon receipt of evidence from the city engineer that the construction of specific improvements can be expected to render the land suitable; thereafter, construction upon such land shall be prohibited until the specified improvements have been planned and construction guaranteed.**

Sec. 30-21. Street location and arrangement.

- (a) Whenever a tract to be subdivided embraces any part of a street designated in an adopted city streets and highways plan, such street shall be platted in conformance therewith.
- (b) Street layout shall provide for the continuation of such streets as the city may designate.
- (c) Certain proposed streets, as designated by the city, shall be extended to the tract boundary to provide future connection with adjoining unplatted lands.
- (d) Local streets shall be so arranged as to discourage their use by through traffic.
- (e) Where a proposed subdivision abuts or contains an existing or proposed arterial route, the city may require marginal access streets or reverse frontage with non-access easements along the arterial route, or such other treatment as may be justified for protection of residential properties from the nuisance and hazard of high volume traffic, and to preserve the traffic function of the arterial route.
- (f) **Streets shall be so arranged in relation to existing topography as to produce desirable lots of maximum utility and streets of reasonable gradient, and to facilitate adequate drainage.**

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(g) Half-streets shall be discouraged except where necessary to complete a street pattern already begun, or to insure reasonable development of a number of adjoining parcels. Where there exists a platted half-street abutting the tract to be subdivided, and said half-street furnishes the sole access to residential lots, the remaining half shall be platted within the tract.

Sec. 30-22. Street and block design.

All street and block design shall conform to the City of Tempe, public works department, division of engineering, "engineering design criteria" manual.

Sec. 30-23. Pedestrian ways and multi-use paths.

Pedestrian ways and multi-use paths may be required where essential for circulation, or access to schools, playgrounds, shopping centers, transportation, and other community facilities. Pedestrian ways and multi-use paths may be used for utility purposes.

Sec. 30-24. Lot planning.

(a) Lot width, depth, and area shall comply with the minimum requirements of the zoning ordinance and shall be appropriate for the location and character of development proposed, and for the type and extent of street and utility improvements being installed. In general, urban density of three (3) or more lots per gross acre must have urban street and utility improvements. "Urban improvements" is interpreted to mean paved and curbed streets, sidewalks, **local storm drainage system**, public water supply, and, wherever reasonably possible, public sanitary sewerage.

(b) **Where steep topography, unusual soil conditions, or drainage problems exist or prevail**, the commission may recommend special lot width, depth, and area requirements which exceed the minimum requirements of the particular zoning district.

(c) Lot depths shall conform to zoning ordinance standards.

(d) Side lot lines shall be substantially at right angles or radial to street lines, except where other treatment may be justified in the opinion of the city.

(e) Every lot shall abut upon a public street or furnish satisfactory access thereto.

(f) Single-family residential lots extending through the block and having frontage on two (2) parallel streets shall not be permitted; backing of lots to thoroughfares shall be prohibited except where expressly permitted by this chapter or where justified in the opinion of the city.

Sec. 30-25. Easement planning.

(a) *Utility easements.* Easements for utilities shall be provided along side lot lines, three (3) feet on each side of lot lines for distribution facilities.

(b) *Utility easements on curvilinear streets.* For lots facing on curvilinear streets, utility easements or alleys may consist of a series of straight lines with points of deflection not less than one hundred twenty (120) feet apart. Points of deflection should always occur at the junction of side and rear lot lines on the side of the exterior angle. Curvilinear easements or alleys may be provided, providing that the minimum radius for the alley or easement shall be not less than eight hundred (800) feet.

(c) Drainage easements. Where a stream or important surface drainage course abuts or crosses the tract, **dedication of a public drainage easement of a width sufficient to permit widening, deepening, relocating, or protecting said water course shall be required.**

(d) *Lot areas.* Land within a public street or **drain easement** or land within a utility easement for major power transmission (tower) lines or pipelines shall not be considered a part of the minimum required lot area except where lots exceed one-half (1/2) acre in area. This shall not be construed as applicable to land involved in utility easements for distribution or service purposes.

(e) *Bus bay and shelter easements.* All lots at far side of arterial to arterial and arterial to collector intersections shall provide bus bay and shelter easements as shown in the City of Tempe Standard Details.

(f) *Multi-use path easements.* All lots abutting multi-use corridors as designated by the most recent update of the Tempe bikeway plan and map shall provide easements as shown in the City of Tempe Standard Details.

Sec. 30-26. Street naming.

Subdivider may propose the street names subject to approval by the city engineer at the preliminary plat stage.

Secs. 30-27—30-29. Reserved.

ARTICLE IV. STREET AND UTILITY IMPROVEMENT REQUIREMENTS

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Sec. 30-30. Purpose.

It is the purpose of this article to establish the minimum acceptable standards for improvement of public streets and utilities, to define the responsibility of the subdivider in the planning, construction, and financing of public improvements, and to establish procedures for review and approval of engineering plans.

Sec. 30-31. Engineering plans.

(a) Engineering plans shall be submitted for all improvements required in streets, alleys or easements required as a condition to plat approval and shall be the responsibility of the subdivider; provided, however, that this requirement may be met by participation in an improvement district approved by the city.

(b) It shall be the responsibility of the subdivider to have prepared by an engineer, registered in the State of Arizona, a complete set of engineering plans, satisfactory to the city engineer, for construction of required improvements. Such plans shall be based on the approved preliminary plat and be prepared in conjunction with the final plat. Engineering plans shall be approved by the city engineer prior to recordation of final plat.

Sec. 30-32. Construction and inspection.

(a) All relocation, tiling, and reconstruction of irrigation facilities shall be constructed to standards of the owning utility and the city engineer.

(b) All improvements in the public right-of-way shall be constructed under the inspection and approval of the city department having jurisdiction. Construction shall not be commenced until a permit has been issued for such construction, and if work has been discontinued for any reason, it shall not be recontinued until after notifying in advance the department having jurisdiction.

(c) All underground utilities to be installed in street shall be constructed prior to the surfacing of such street. Service stubs to platted lots within the subdivision for underground utilities shall be placed to such length as not to necessitate disturbance of street improvements when service connections are made.

Sec. 30-33. Required improvements.

(a) *Streets and alleys.* All streets and alleys within the subdivision shall be graded and surfaced to cross-sections, grades, and standards approved by the city engineer. Where there are existing streets adjacent to the subdivision, subdivision streets shall be improved to the intercepting paving line of such existing streets. Dead-end streets serving more than four (4) lots shall be provided a graded and surfaced temporary turning circle.

(b) *Curbs.* Where streets are to be paved, concrete curb, curb and gutter, or valley gutter as designated by the city engineer shall be installed in accordance with approved city standards.

(c) *Sidewalks.* Sidewalks shall normally be required on both sides of streets and shall be constructed with materials and a width, line, and grade approved by the city engineer in accordance with approved city standards.

(d) *Streets name signs.* Signs shall be placed at all street intersections and be in place by the time the street pavement is ready for use. Specifications for design, construction, location, and installation shall be in accordance with approved city standards.

(e) *Storm drainage.* Proper and adequate provision shall be made for disposal of storm waters; this shall apply equally to grading of private properties and to public streets. Existing major water courses shall be maintained and dedicated as drainage ways. The type, extent, location, and capacity of drainage facilities shall be determined for the individual subdivision by the city engineer and shall be constructed in accordance with approved city standards.

(f) *Sanitary sewage disposal.* Sewage disposal facilities shall be installed to serve each lot and be subject to the following standards and approvals:

(1) Individual systems may be constructed only in areas not reasonably accessible to a public sewer system, and then only when the following conditions are met to the satisfaction of the county health department.

a. Soil absorptivity is adequate.

b. Construction complies with approved standards.

c. Location of septic tank and seepage pits or leach lines or disposal beds in relation to property lines and buildings, and water supply wells and lines are acceptable. Location shall be such that efficient and economical connection can be made to a future public sewer.

(2) Public sanitary sewers shall be installed in areas which are reasonably accessible to an existing sewer system and shall be constructed to plans, profiles, and specifications approved by the county health department and city departments having jurisdiction.

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(3) In areas where public sanitary sewers are not reasonably accessible but where the future owning agency agrees to effect temporary disposal of sewage, the subdivider shall plan and construct sewers within and for the subdivision for connection with a future public system.

(g) *Water supply.* Each lot shall be supplied with safe, pure, and potable water in sufficient volume and pressure for domestic use and fire protection, in accordance with city standards.

(h) *Irrigation facilities.* All irrigation facilities to remain within the boundaries of the tract or in an abutting one-half (1/2) street or alley right-of-way shall be tiled in accordance with standards of the owning agency and relocated or abandoned as directed by the city engineer and the owning agency. Where street improvement requires relocation of control gates or other structures, such relocation and reconstruction shall conform to city engineer and owning agency requirements.

(i) *Monuments.* Permanent monuments shall be installed in accordance with current city standards at all corners, angle points, and points of curve and at all street intersections. After all improvements have been installed, a registered land surveyor or engineer shall check the location of monuments and certify their accuracy.

(j) *Lot corners.* Iron pipe shall be set at all corners, angle points, and points of curve for each lot within the subdivision prior to the recording of the plat.

(k) *Underground utility lines.* All utility lines shall be placed underground. The requirement for underground electrical lines shall not apply to feeder lines from the substation to the subdivision.

Secs. 30-34—30-39. Reserved.

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ARTICLE III. SUBDIVISION DESIGN PRINCIPLES AND STANDARDS

Sec. 30-20. General.

(a) Every subdivision shall conform to the requirements and objectives of the general plan, or any parts thereof, as adopted by the commission and the city council, to the zoning ordinance and to other ordinances and regulations of the city, and to the Arizona Revised Statutes.

(b) Where the tract to be subdivided contains all or any part of the site of a park, school, flood control facility, or other public area as shown on the general plan or as recommended by the commission, such site should be dedicated to the public or reserved for acquisition by the public within a specified period of time. An agreement should be reached between the subdivider and the appropriate public agency regarding time, method and cost of such acquisition. In the event the commission determines that such an agreement has not been reached within a reasonable period of time, then the commission may make a determination that the requirements of this section have been met.

(c) Land which is subject to periodic flooding, land which cannot be properly drained, or other land which, in the opinion of the city, is unsuitable for any use shall not be subdivided; except that the city may approve subdivision of such land upon receipt of evidence from the city engineer that the construction of specific improvements can be expected to render the land suitable; thereafter, construction upon such land shall be prohibited until the specified improvements have been planned and construction guaranteed.

Sec. 30-21. Street location and arrangement.

(a) Whenever a tract to be subdivided embraces any part of a street designated in an adopted city streets and highways plan, such street shall be platted in conformance therewith.

(b) Street layout shall provide for the continuation of such streets as the city may designate.

(c) Certain proposed streets, as designated by the city, shall be extended to the tract boundary to provide future connection with adjoining unplatted lands.

(d) Local streets shall be so arranged as to discourage their use by through traffic.

(e) Where a proposed subdivision abuts or contains an existing or proposed arterial route, the city may require marginal access streets or reverse frontage with non-access easements along the arterial route, or such other treatment as may be justified for protection of residential properties from the nuisance and hazard of high volume traffic, and to preserve the traffic function of the arterial route.

(f) Streets shall be so arranged in relation to existing topography as to produce desirable lots of maximum utility and streets of reasonable gradient, and to facilitate adequate drainage.

(g) Half-streets shall be discouraged except where necessary to complete a street pattern already begun, or to insure reasonable development of a number of adjoining parcels. Where there exists a platted half-street abutting the tract to be subdivided, and said half-street furnishes the sole access to residential lots, the remaining half shall be platted within the tract.

Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



Sec. 30-22. Street and block design.

All street and block design shall conform to the City of Tempe, public works department, division of engineering, "engineering design criteria" manual.

Sec. 30-23. Pedestrian ways and multi-use paths.

Pedestrian ways and multi-use paths may be required where essential for circulation, or access to schools, playgrounds, shopping centers, transportation, and other community facilities. Pedestrian ways and multi-use paths may be used for utility purposes.

Sec. 30-24. Lot planning.

(a) Lot width, depth, and area shall comply with the minimum requirements of the zoning ordinance and shall be appropriate for the location and character of development proposed, and for the type and extent of street and utility improvements being installed. In general, urban density of three (3) or more lots per gross acre must have urban street and utility improvements. "Urban improvements" is interpreted to mean paved and curbed streets, sidewalks, local storm drainage system, public water supply, and, wherever reasonably possible, public sanitary sewerage.

(b) Where steep topography, unusual soil conditions, or drainage problems exist or prevail, the commission may recommend special lot width, depth, and area requirements which exceed the minimum requirements of the particular zoning district.

(c) Lot depths shall conform to zoning ordinance standards.

(d) Side lot lines shall be substantially at right angles or radial to street lines, except where other treatment may be justified in the opinion of the city.

(e) Every lot shall abut upon a public street or furnish satisfactory access thereto.

(f) Single-family residential lots extending through the block and having frontage on two (2) parallel streets shall not be permitted; backing of lots to thoroughfares shall be prohibited except where expressly permitted by this chapter or where justified in the opinion of the city.

Sec. 30-25. Easement planning.

(a) *Utility easements.* Easements for utilities shall be provided along side lot lines, three (3) feet on each side of lot lines for distribution facilities.

(b) *Utility easements on curvilinear streets.* For lots facing on curvilinear streets, utility easements or alleys may consist of a series of straight lines with points of deflection not less than one hundred twenty (120) feet apart. Points of deflection should always occur at the junction of side and rear lot lines on the side of the exterior angle. Curvilinear easements or alleys may be provided, providing that the minimum radius for the alley or easement shall be not less than eight hundred (800) feet.

(c) *Drainage easements.* Where a stream or important surface drainage course abuts or crosses the tract, dedication of a public drainage easement of a width sufficient to permit widening, deepening, relocating, or protecting said water course shall be required.

(d) *Lot areas.* Land within a public street or drain easement or land within a utility easement for major power transmission (tower) lines or pipelines shall not be considered a part of the minimum required lot area except where lots exceed one-half (1/2) acre in area. This shall not be construed as applicable to land involved in utility easements for distribution or service purposes.

(e) *Bus bay and shelter easements.* All lots at far side of arterial to arterial and arterial to collector intersections shall provide bus bay and shelter easements as shown in the City of Tempe Standard Details.

(f) *Multi-use path easements.* All lots abutting multi-use corridors as designated by the most recent update of the Tempe bikeway plan and map shall provide easements as shown in the City of Tempe Standard Details.

Sec. 30-26. Street naming.

Subdivider may propose the street names subject to approval by the city engineer at the preliminary plat stage.

Secs. 30-27—30-29. Reserved.

SITE PLAN CRITERIA

A. GENERAL

Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



1. Allow approximately 15 working days for review of the first submittal, ten (10) days for review of first resubmittal, and five (5) days for all subsequent resubmittals.

2. Each submittal shall have two complete sets of prints of engineering plans. Each resubmittal shall have two complete sets of corrected prints of engineering plans plus the City's redlines of the previous submittal.

B. MINIMUM REQUIREMENTS

1. Include a complete legal description as it appears on the deed.
2. Include a vicinity map showing the property in relation to that of the major streets.
3. Include north arrow (pointing to right or top edge of sheet).
4. Include owner's name or names as it appears on the deed (property, business, developer, etc.) and mailing addresses.
5. Include name, address and phone number of person to whom plans should be returned.
6. Include legal address of property.
7. Show location of and distance to closest fire hydrant.
 - a. Fire hydrants shall be provided to within 150' of any point on the first floor of any building.
 - b. A fire hydrant shall be provided within 150' of any fire department connection.
8. Show location and size of all water meters (existing and/or new) including dimension from property line and gpm needed.
9. Show location and size of all sewer taps (existing and/or new) including dimension from property line.
10. Sidewalks are required adjacent to both sides of all city streets. Arterial streets require 8' wide sidewalks, L-1 streets require 5'-6" wide sidewalks, and all other streets require 6'-0" wide sidewalks.
11. Include a benchmark (use and note City of Tempe datum).
12. Tie property to at least two section and/or quarter corners and show City of Tempe coordinates.
13. Show all lot dimensions, widths of easements, and rights of way, including bearings and distances.
14. Show and dimension the parking lot layout, drainage pattern, proposed spot elevations and existing topography of site and adjacent areas.
15. Show the finished floor elevation (minimum of 8" commercial and 14" residential above lot outfall).
16. Show and dimension all topo in City right of way including pavement, curb, gutter, sidewalk, power poles, medians, traffic signal equipment, street lights, etc.
17. Existing overhead utility lines (other than transmission lines) shall be placed underground per City Code Sections 25-120 through 25-126 and Ordinance No. 88.85.
18. Show and dimension all existing utilities (water, gas, power, irrigation, sewer, storm drain, etc.) and tie to property line and/or street centerline.
19. Distinguish between all existing and proposed construction and clearly show any planned phasing.
20. Show and dimension all existing and proposed curb cuts for driveways per Tempe Standard Detail T-320. Driveway entrances are required on roll curb streets except for single family residential. Driveway curb cuts shall not be located within 100' of the point of intersection of property lines at arterial/arterial or arterial/collector street intersections.
21. Show, dimension and locate all existing streets, sidewalks, driveways, medians and median openings within 125' of the project boundaries on both sides of the street.
22. Provide 45' minimum turn radius for all drives.

Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



23. Show widths of drives for refuse and fire circulation (20' wide minimum). When parking exists on both sides of the drive, it shall be a minimum of 23' wide.

24. Show and dimension proposed and existing perimeter walls, wall heights, spot grades on both sides of walls, and adjacent building faces near property line.

25. Signature block as follows (lower right-hand corner of first sheet):

APPROVAL FOR OFFSITES AND DRAINAGE ONLY

CITY ENGINEER DATE

26. Use 1" = 30' maximum engineering scale and show a bar scale.

27. All plans must be on 24" x 36" sheets and be legible at 50% reduction.

28. Show net area of site in square feet and acres.

29. Surface retention on-site of the 100 year, 1 hour storm per City of Tempe Drainage Criteria is required. Underground retention is not permitted without the specific written approval of the City Engineer.

30. Show calculations for retention volume required and provided, high water levels and bottom elevations for retention areas, rim elevations for drywells and catch basins, invert elevations for drainage pipes and 4:1 maximum side slopes for landscaped retention areas. Maximum depth of 3' in landscaped areas and 1' maximum depth in paved areas (see Figure III in the Drainage Criteria Section also).

31. Show positive grade breaks at all property and right-of-way lines.

32. Include applicable City of Tempe notes (General, Site, Paving, Sewer and Water, On-site Drainage, Street Lighting).

33. Include completed utility company submittals.

34. Include the Permit and "As-Built" Information block.

35. Show existing and proposed landscaping in water, sewer and storm drain easements. No deep-rooted shrubs or trees are allowed.

36. Include the Arizona Registered Civil Engineer's seal, date, and signature.

37. Call out all applicable standard specifications and standard details on the plan.

38. Gates are normally not permitted on refuse enclosures. Where approved, gates crossing an onsite drive shall be left open from 6:00 a.m. to 4:30 p.m. on refuse pickup days. Provide gate details on the engineering plans. Hardware must be externally mounted so as not to impact enclosure internal dimensions.

39. A boundary survey tied to the Tempe Coordinate System and/or a title report less than three months old may be required.

40. Show all underground electric circuits, conduit, traffic signal poles, pole foundations, pull boxes and other traffic furniture approved by the Transportation Division. Show locations of any required street lights to be installed with project.

41. Show the Engineering Private Development (EN) Number and Development Services (DS) Number (assigned during the first review) in the right hand bottom margin on each sheet. Use 36 pt. Helvetica Kroy or 350 CL Leroy Lettering.

42. Provide title block on each sheet showing project name, type of drawing (water, sewer, grading and drainage, etc.) sheet number and quarter section.

43. Plans are accepted for six (6) months following approval date. One 6 month extension is allowed and after 12 months, the approval expires if permits have not been picked up and paid for.

44. Provide an estimate of quantities of construction items, including earthwork cut and fill (see following sheet for list).

Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



APPENDIX E



Broadway Road @ Rural intersection looking west.



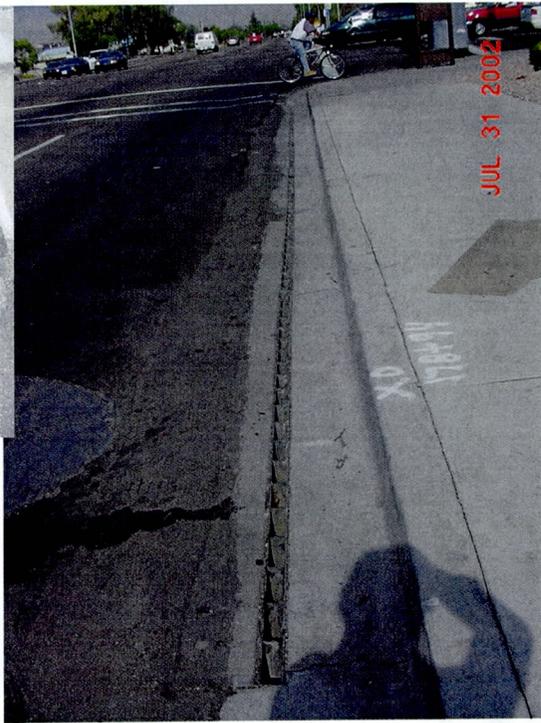
From frontage road looking east on the north side of Broadway



Broadway Road east of Rural looking west. Shows frontage road on the north side.



A close look a the catch basin on the north side of Broadway Road East of Rural



Typical catch basins and slotted drains along
Broadway Road west of Rural Road.





Newer developments include retention basins for on-site drainage.



Typical on-site retention at an apartment complex.
East of Rural Road



On Vista Del Cerro looking west at Rural Road.



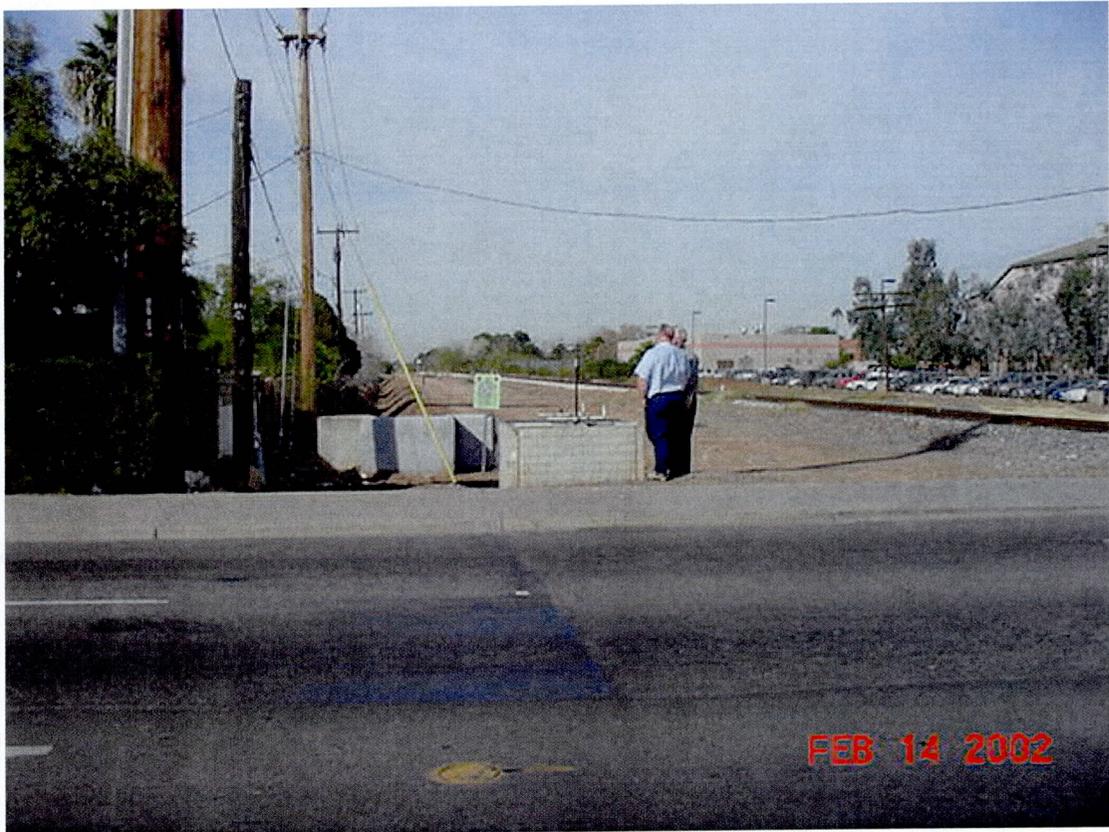
Many of the older commercial developments drain to the street.



Looking northwest at UPRR north of the Daley Park Neighborhood.



Pedestrian entrance to Vista Del Cerro from Rural Road. Note elevation difference from Rural Road..



Looking west at the SRP structure and head wall from Rural Road.



Looking in SRP structure. Inlet is at the top, the right gate to ditch is closed, left gate to storm drain is open.



The SRP pump and drain ditch north of the Daley Park Neighborhood. Looking west from Rural Road.



Hole in fence to allow storm water to discharge from private property to the SRP Ditch



Hole in fence to allow storm water to discharge from private property to the SRP Ditch



SRP Ditch at west end of neighborhood near the park.



Valley gutter leading and catch basin at the corner of Vista Del Cerro and Ventura Drive



Discharge pipe from the catch basin located at the corner of Vista Del Cerro and Ventura Drive.



At west end of SRP ditch looking southwest across Daley Park. Ditch bends 90 deg to north here.



Ditch crosses UPRR at this location. Two pipes, one in ditch, another at left edge of picture.



Outlet to culverts under UPRR (north side of tracks)



North of the UPRR, the SRP flow in the ditch enters this pipe.



College Avenue looking north at the UPRR crossing



The Daley Park Neighborhood is named for the park adjacent to the neighborhood

Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



APPENDIX F

SOUTHERN PACIFIC
TRANSPORTATION COMPANY

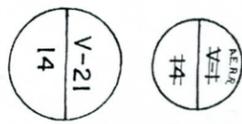
RIGHT OF WAY AND TRACK MAP

MAIN LINE

MARICOPA COUNTY ARIZONA

FROM TATION A.E. 1360+82 TO STATION "H" 100+91.5

SCALE
VALUATION DARTMENT
NANC O CAL ORNA



(Scale Modified for Presentation)

Daley Park Neighborhood

Railroad

Rural Road

M.P. - 916
RURAL

N
S
W
E

1255.0'
24" Conc. Pipe 248' Lg. 52+16.0
916.23

Irrigation Ditch 58+72.2

24" Conc. Pipe 247' Lg. 59+22.0
916.35

NO. 2

NO. 3

Cattle Gd. (Sheffield) 64+86.0

Automat. Xing Gates

1251.0'

County Road Xing. (C.S. 20) 65+14.0

Cattle Gd. (Sheffield) 65+50.0

Telephone Line
"H" 64+86.0

65+37- 12" water pipe

"H" 65+19.0

"H" 65+52.0 65+28 21" V.C. Sewer Pipe
65+39.0 24" Conc. Pipe 246' Lg. 916-E
916.47

P.S. 73+39.3

916.71
24" Conc. Pipe 247' 78+26.0

83+07.6 Irrigation Ditch

P.S. 83+22.0

VISTA DEL CERRO

SPENCE AVE.

Val. Sec. S.P. Co. ART. 22-36
P&E. 542+86.0 E
8-25' chords
544+86.0

30' W
20'
No. 5
91+62 L 24" x 916.97' C.P.

NORM

Mile
Tel. Booth 4

1917
G. & S. R. W.
T. A. N. P. A. F.
23

RR Plans date back to 1926. Modifications to plans made in text blocks only. Newer plans not available according to the UPRR.

Union Pacific Railroad Right-of-Way Plans

Source: Union Pacific Railroad

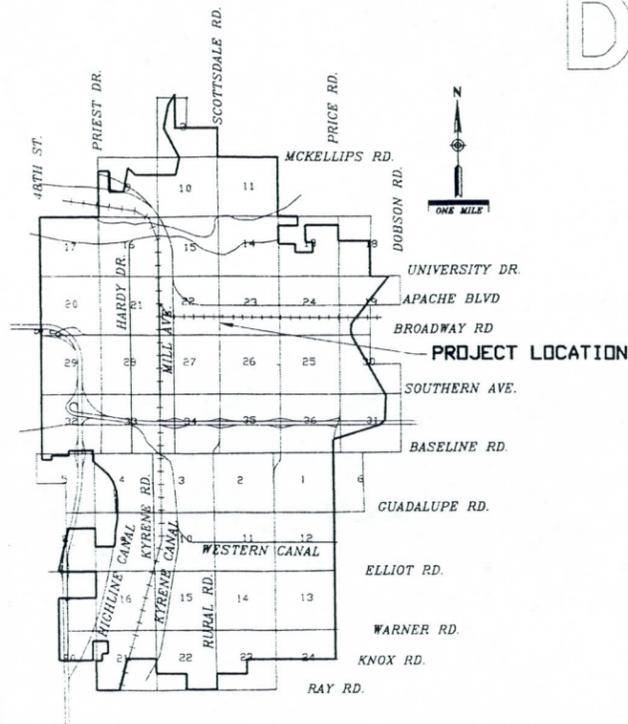
Candidate Assessment Report: Rural & Broadway

Flood Control District of Maricopa County, Arizona...



APPENDIX G

CITY OF TEMPE PUBLIC WORKS DEPARTMENT DIVISION OF ENGINEERING



TEMPE DRAINAGE VISTA DEL CERRO DR. AND ENCANTO DR. PROJECT NO. 996981

MAYOR
NEIL GIULIANO

CITY COUNCIL

P. BEN ARREDONDO
DENNIS J. CAHILL
LEONARD COPPLE
HUGH HALLMAN
BARBARA J. CARTER
MARK W. MITCHELL

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PLAN	2

UTILITY INFORMATION

AT & T	DATE
US WEST	DATE
ARIZONA PUBLIC SERVICE CO.	DATE
AIR PRODUCTS	DATE
SALT RIVER PROJECT-WATER	DATE
SALT RIVER PROJECT-POWER	DATE
EL PASO NATURAL GAS CO.	DATE
SOUTHWEST GAS CORP.	DATE
CABLE - TV	DATE

APPROVED

Acting CITY ENGINEER

9/20/00
DATE



BROOKS, HERSEY AND ASSOCIATES, INC.
ENGINEERS/SURVEYORS
4002 East Elwood Street, 16
Phoenix, Arizona 85040
(602) 437-3733

**TEMPE NEIGHBORHOOD
DRAINAGE STUDY #996981**

JOB NO. 129-13FF DATE: 9/20/00 SHEET 1 OF 2

DESIGN: DDC
DRAWN: ACS
CHECK: JAB
SCALE:
HORIZ: 20'
VERT: 2'

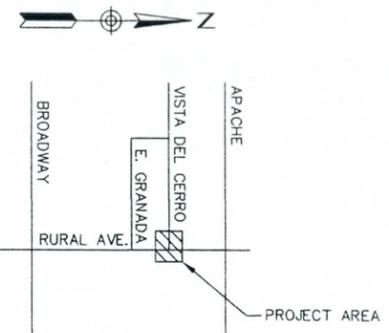
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<input type="checkbox"/> WATER	<input type="checkbox"/> CITY IRRIG.
<input type="checkbox"/> WATER-RECLAIMED	<input type="checkbox"/> BIKE PATH
<input checked="" type="checkbox"/> STORM DRAIN/DRYWELL	<input type="checkbox"/> LANDSCAPE/SPRINKLER
<input type="checkbox"/> PAVING	<input type="checkbox"/> STREET LIGHTS
<input type="checkbox"/> OFFSITE (C.G., SW, BV)	<input type="checkbox"/> BUILDINGS
<input type="checkbox"/> GRADING/DRAINAGE	<input type="checkbox"/> FLOODPLAIN
	<input type="checkbox"/> OTHER

AS-BUILT PLANS CHECKED FOR FIELD CHANGES
INSPECTOR: DATE: 9/20/00 PARCEL # _____ PROJECT # _____

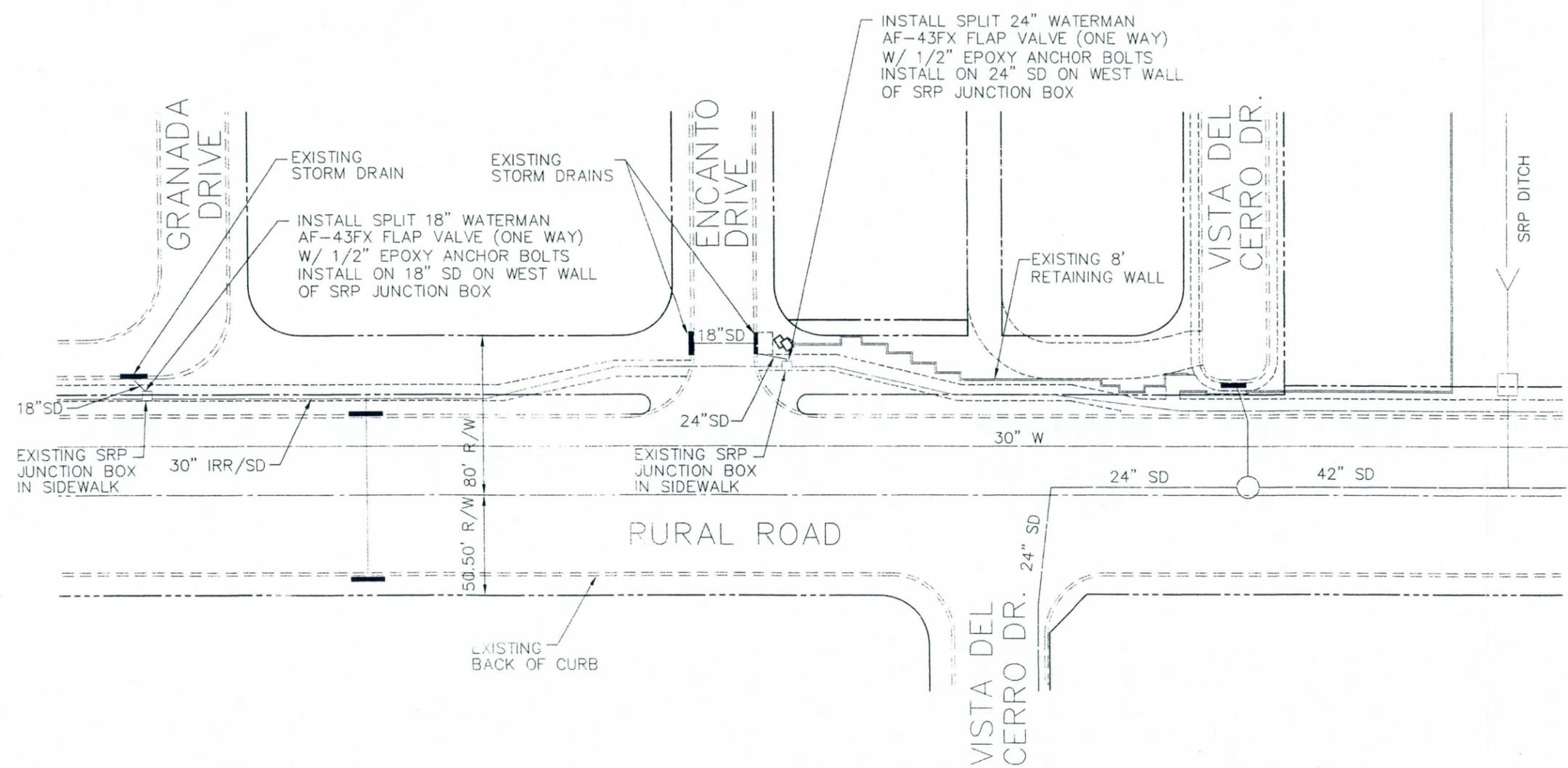
SE22N4

996981B Drainage - Vista Del Cerro Dr + Encanto Dr.

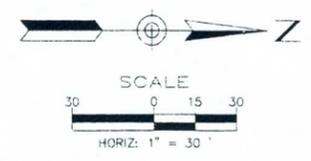
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VICINITY MAP
N.T.S.



PLAN VIEW



BENCHMARK
CITY OF TEMPE BENCHMARK IS A BRASS CAP IN HANDHOLE, ELEVATION 1167.29 LOCATED AT THE INTERSECTION OF BROADWAY AND COLLEGE.

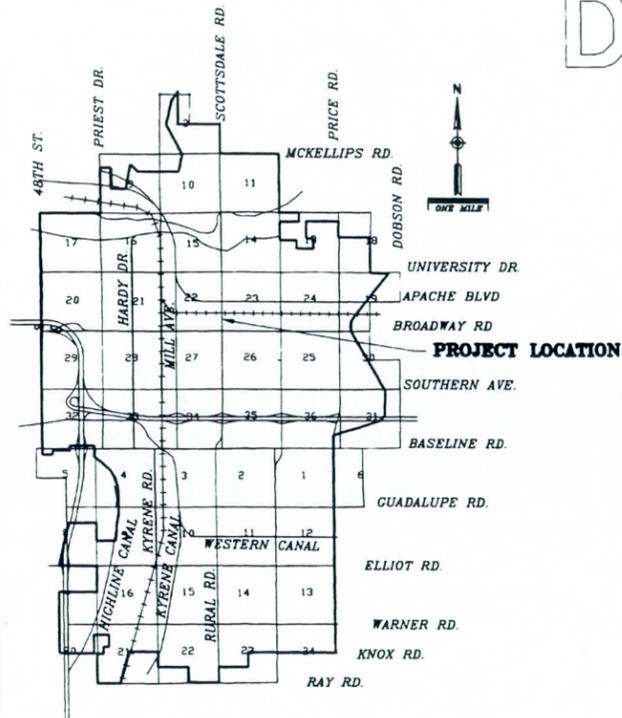


<p>BROOKS, HERSEY AND ASSOCIATES, INC. ENGINEERS/SURVEYORS 4402 East Elwood Street, 16 Phoenix, Arizona 85040 (602) 437-0733</p>	DESIGN: DDC
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	HORIZ: 20'
	VERT: 2'
<p>TEMPE NEIGHBORHOOD DRAINAGE STUDY #996981 VISTA DEL CERRO</p>	
<p>JOB NO. 129-13fp DATE: 7-11-00 SHEET 2 OF 2</p>	

996981

20F2

CITY OF TEMPE PUBLIC WORKS DEPARTMENT DIVISION OF ENGINEERING



TEMPE DRAINAGE VISTA DEL CERRO DR. AND ENCANTO DR. PROJECT NO. 996981

MAYOR
NEIL GIULIANO

CITY COUNCIL
P. BEN ARREDONDO
DENNIS J. CAHILL
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JOSEPH SPRACALE

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CABLE - TV	DATE

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DETAILS	3

APPROVED

[Signature]
CITY ENGINEER

2-28-01
DATE

RECORD DRAWINGS
These plans represent "As-Built" information provided by Luma's Contracting and Resident Inspector P. Owen 8101



BROOKS, HERSEY AND ASSOCIATES, INC.
ENGINEERS/SURVEYORS
4002 East Rhoad Street, 10
Phoenix, Arizona 85040
(602) 437-3733

DESIGN: DDC
DRAWN: ACS
CHECK:
SCALE:
HORIZ: 20'
VERT: 2'

**TEMPE NEIGHBORHOOD
DRAINAGE STUDY #996981**

JOB NO. 129-13FF DATE: 2/27/01 SHEET 1 OF 3

AS-BUILT INFORMATION IS INCLUDED IN THESE AREAS ON THIS SET OF DRAWINGS	PERMITS REQUIRED FOR THIS SET OF DRAWINGS
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AS-BUILT PLANS CHECKED FOR FIELD CHANGES	PARCEL #
INSPECTOR: F. EVANS	DATE: 2/28/01

AS-BUILTS 2/28/01

SE22N4

GD

996981C

TEMPE DRAINAGE - VISTA DEL CERRO AND ENCANTO

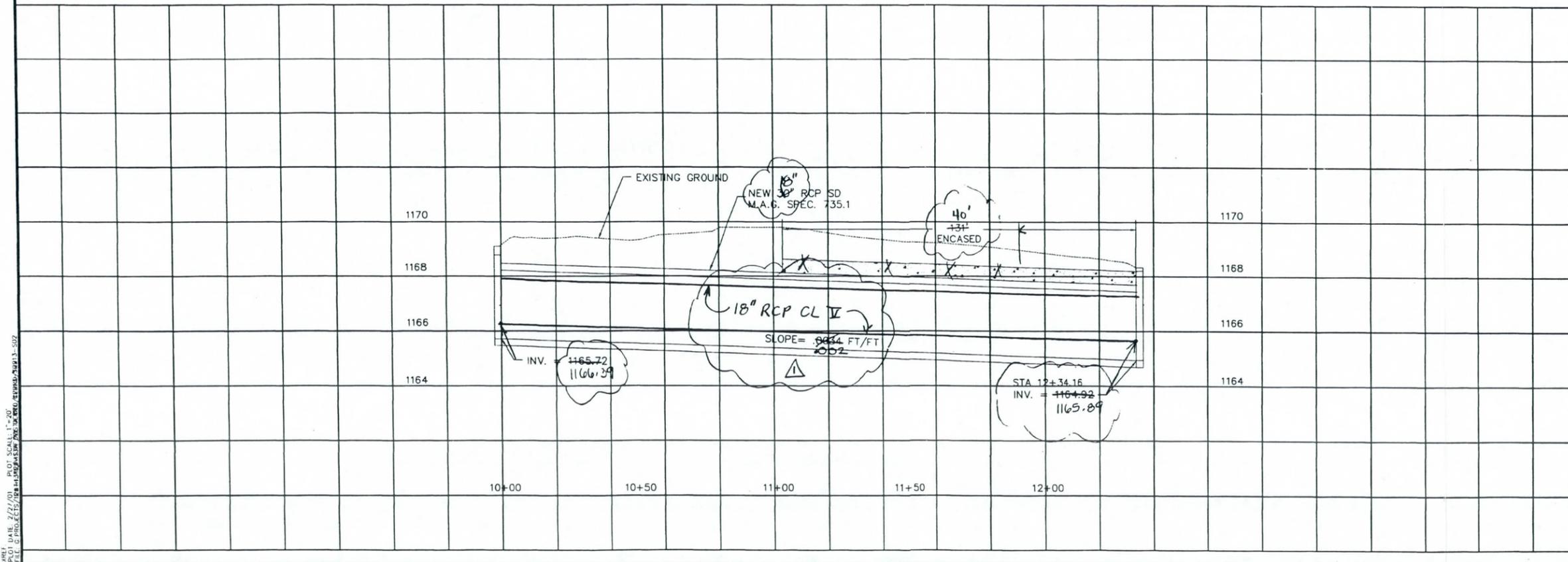
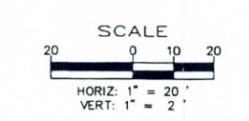
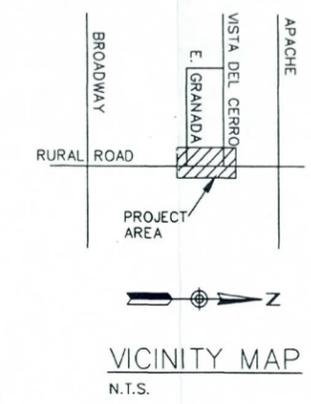
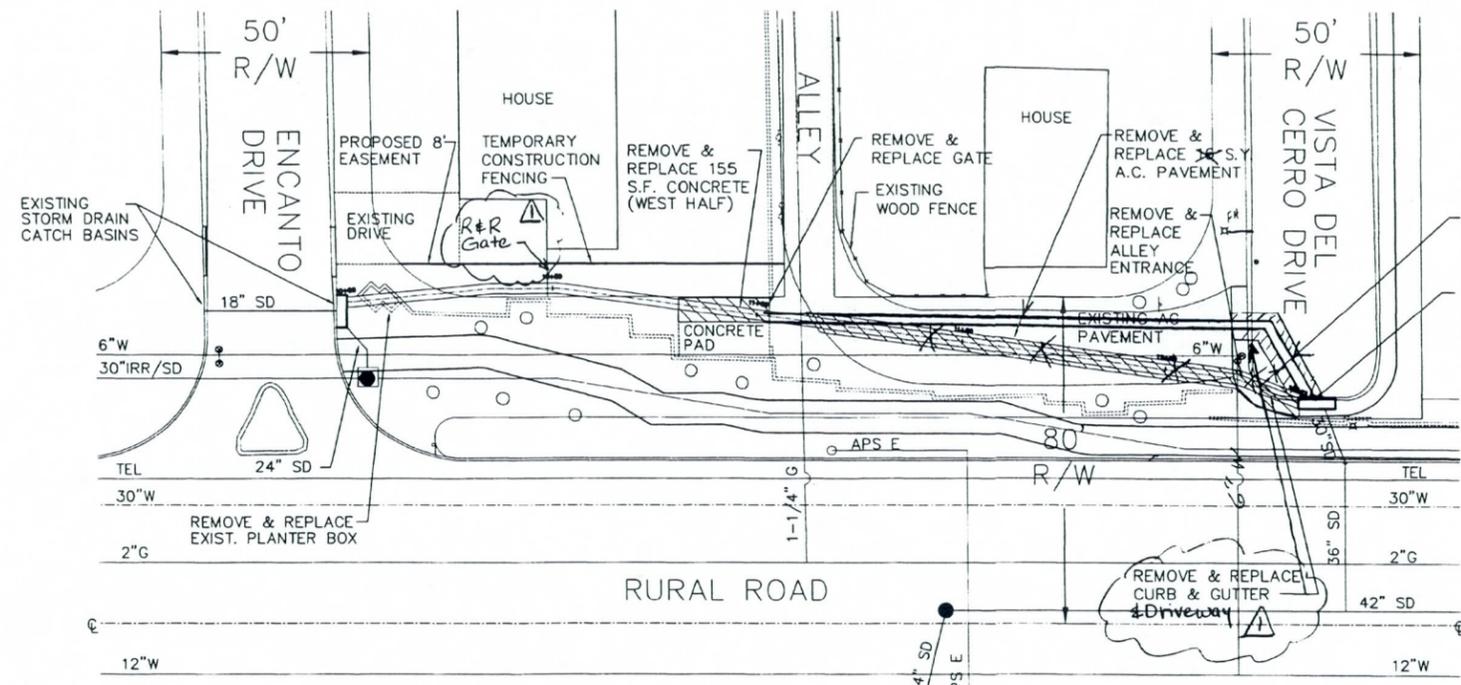
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- ### LEGEND
- EXIST. STREET SIGN
 - EXIST. WATER VALVE
 - EXIST. IRRIG. MANHOLE
 - EXIST. TREE
 - EXIST. CURB & GUTTER
 - EXIST. PROPERTY LINE
 - EXIST. WATER 12"W
 - EXIST. GAS 2"G
 - EXIST. TELEPHONE TEL
 - EXIST. APS ELECTRICAL APS E
 - EXIST. R/W
 - EXIST. RETAINING WALL
 - NEW 30" STORM DRAIN

- ### QUANTITIES
- | | | |
|--------------------------------|-------------------|------|
| REMOVE & REPLACE CURB & GUTTER | 25 | L.F. |
| AC PAVEMENT | 16 60 | S.Y. |
| 5" CONCRETE SLAB | 162 | S.F. |
| 4' SIDEWALK | 12 100 | S.F. |
| GATE | 2 | EA. |
| FLOWER BOXES | 1 | EA. |
| NEW 18" RCP PIPE CL V | 245 | L.F. |
| NEW 30" RCP PIPE CL V | 235 | L.F. |
| TYPE 'A' CATCH BASIN | X | EA. |
| EXIST. CATCH BASIN CONNECTION | X 2 | EA. |
| CONCRETE DRIVE ENTRANCE | 92 | SF |
| TEMPORARY CONST FENCING | 139 | L.F. |

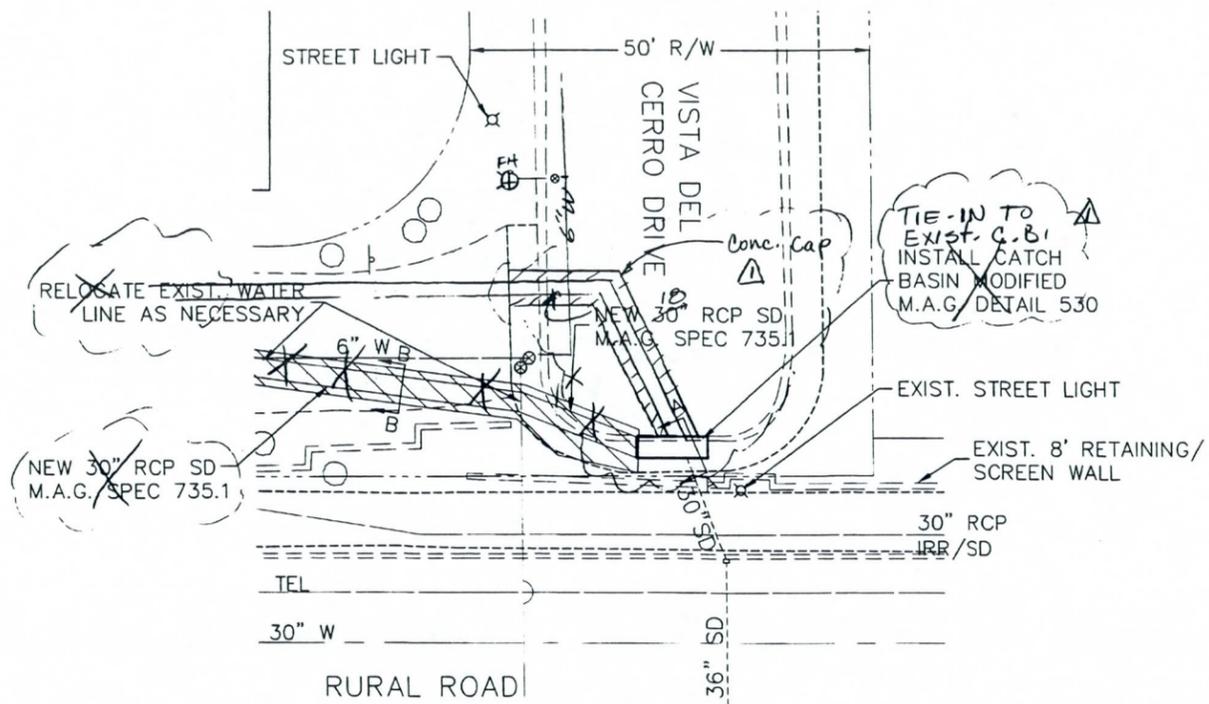
As-built Info.

IMPROVEMENT PLANS TEMPE DRAINAGE

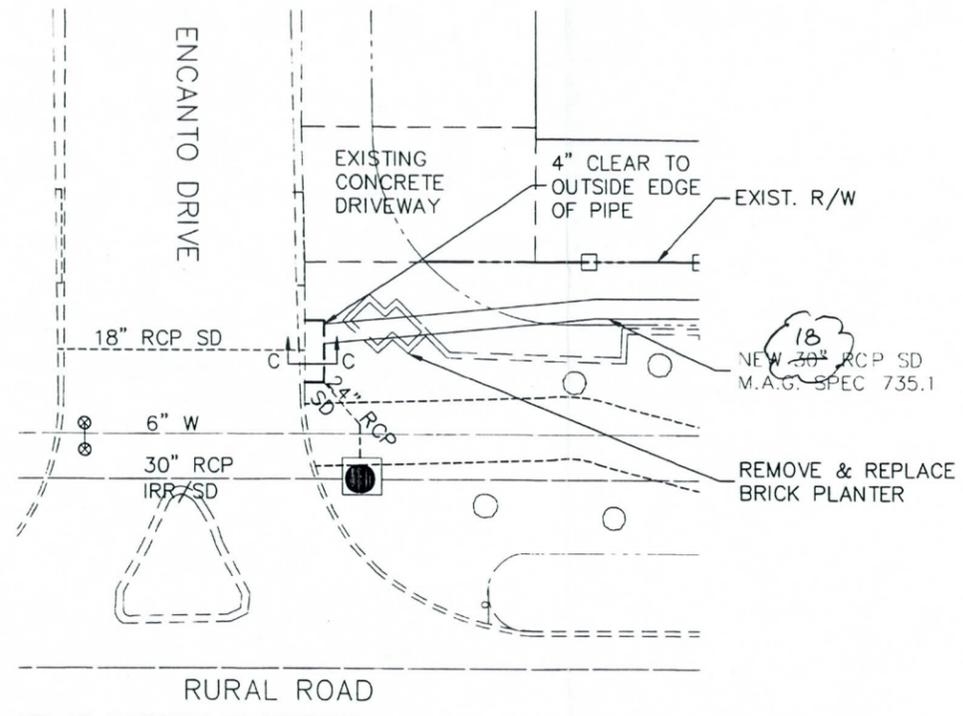


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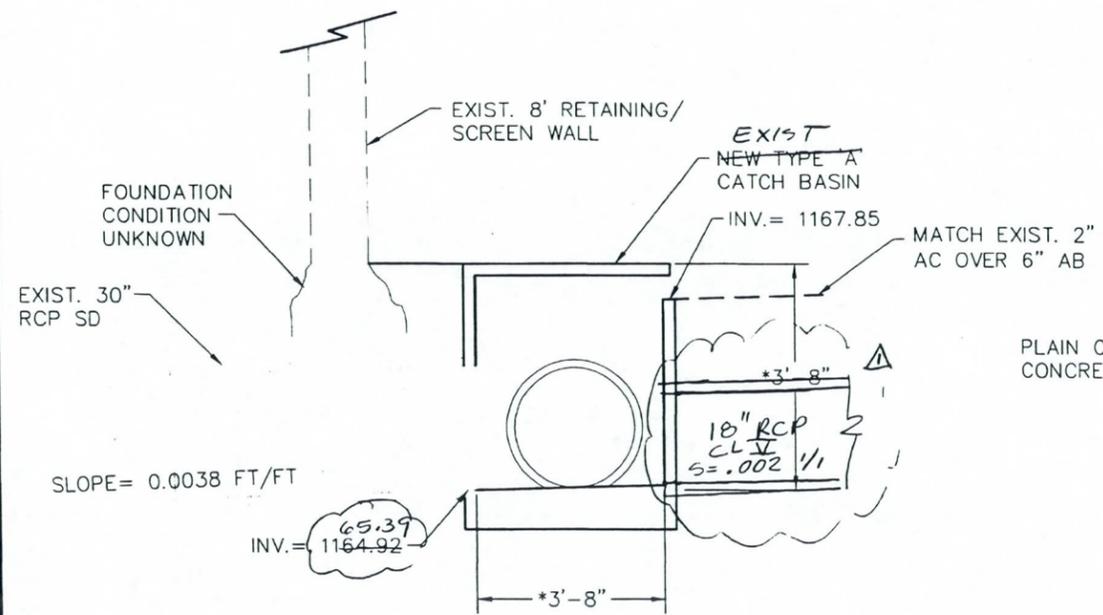
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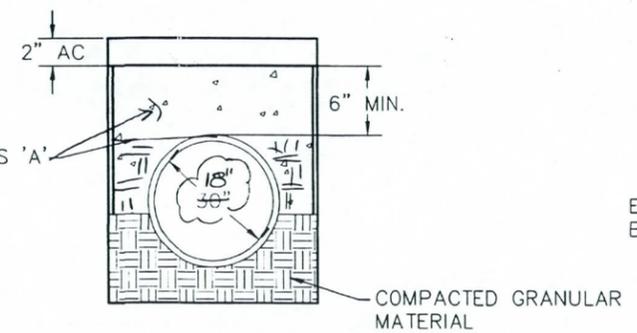
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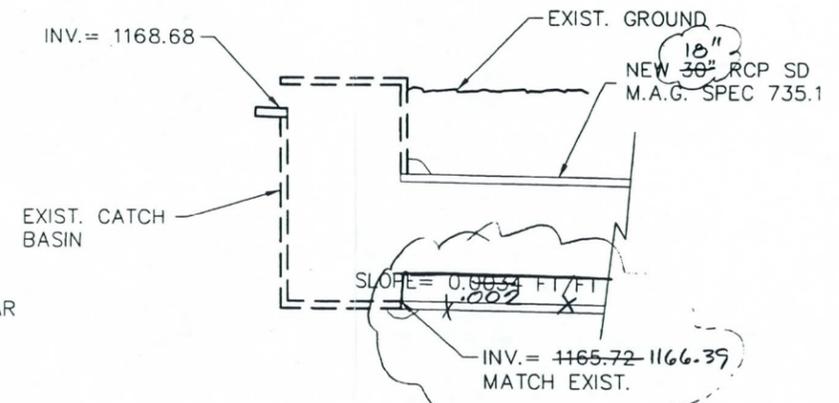
DETAIL 2
1"=10'



SECTION A-A (SEE DETAIL ABOVE)
N.T.S.



SECTION B-B (SEE DETAIL ABOVE)
N.T.S.



SECTION C-C (SEE DETAIL ABOVE)
N.T.S.

*DIMENSIONS MODIFIED FROM M.A.G. DETAIL

REF: PROJECTS
PLOT DATE: 2-27-01
FILE DETAILS
PLOT DATE: 2-27-01
PLOT DATE: 2-27-01
PLOT DATE: 2-27-01



	BROOKS, HERSEY AND ASSOCIATES, INC. ENGINEERS/SURVEYORS 5005 E. BROADWAY, SUITE 100 PHOENIX, ARIZONA 85040 (602) 497-0755 (480) 888-0204	DESIGN: DDC DRAWN: ACS CHECK: DDC
	TEMPE DRAINAGE IMPROVEMENTS VISTA DEL CERRO	SCALE: HORZ: 40' VERT: N/A
	10775 DEWAYNE LEAN CURTIS LICENSE NO. 10775 STATE OF ARIZONA	
	JOB NO. 129-13FP DATE: 2-27-01 SHEET 3 OF 3	

996981