CANDIDATE ASSESSMENT REPORT

TOLLESON – SPRR AND VAN BUREN STREET AT 91ST AVENUE

FCD 98-23

PCN # 565-01-01

August 4, 1999

Prepared for:

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

Prepared by:

Primatech, LLC
2929 North 44th Street, Suite 228
Phoenix, Arizona 85018

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PRIMATECH
ENGINEERS & CONSULTANTS

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DATE: 8/9/99

PROJECT NO: FCD 98-23

TO: Nick Sciarro, Project Manager
Flood Control District of Maricopa County

ADDRESS: 2801 W. Durango Street
Phoenix, AZ 85009
Tel. 602-506-7137

REFERENCE: Tolleson CAR

TRANSMITTING HEREWITH:

Five Copies of Final Candidate Assessment Report – Tolleson – SPRR and Van Buren Street at 91st Avenue.

- ☐ For Approval
- ☐ For Your Files
- ☐ As Requested
- ☐ Returned
- ☐ For Your Use
- ☒ Review

REMARKS: We have submitted one copy to City of Tolleson and one copy to City of Avondale.

Please Call if you have any question.

FROM: Aihua Tang

CANDIDATE ASSESSMENT REPORT

TOLLESON – SPRR AND VAN BUREN STREET AT 91ST AVENUE

Executive Summary

Project Requested by: City of Tolleson
9555 West Van Buren Street
Tolleson, Arizona 85353
Business Phone: (602) 936-7111

Recommended Projects:

The District has defined that the purpose of the Candidate Assessment Report process is to analyze existing information and develop project data to serve as a planning tool for evaluation of projects, proposed by both outside agencies and the District, for inclusion into the Capital Improvement Program (CIP). The City of Tolleson submitted two project requests to the District. The following are brief descriptions of the project requests submitted by the City of Tolleson:

- "Van Buren Street Drainage" - Evaluation of intersection flooding along Van Buren Street in the Vicinity of 95th and 96th Avenues.
- "Southern Pacific Railroad Tracks Drainage Improvements" – Evaluation of potential flood control improvements to protect property owners located within the current FEMA floodplain that extends along the north side of the Southern Pacific Railroad (SPRR) tracks between 91st and 99th Avenues. The railroad tracts that extend through the project study area were previously operated by the Southern Pacific Railroad; however, the tracts currently appear to be operated jointly by the Union Pacific and Southern Pacific Railroad (i.e. UP/SPRR).

For purposes of this CAR, the two project requests submitted by the City of Tolleson are addressed as one project. In addition, the scope of the Tolleson CAR was expanded to also include evaluation of drainage issues associated with 91st Avenue, between the I-10 Freeway and the UP/SPRR tracks

Problem Identification and Background:

Two features that play a significant role in defining the drainage patterns in the study area are the RID Canal and the Union Pacific Southern Pacific Railroad (UP/SPRR). The RID Canal and the UP/SPRR embankments are primarily elevated within the study area. Roadways that cross these features typically rise to meet the elevated grade of the canal and railroad embankments. The railroad, canal, and roadway embankments collect storm water and form both ponding areas and relatively shallow floodplains. The floodplains associated with the canal, roadway, and railroad embankments in the Tolleson area have been delineated and documented in a report titled "Floodplain Delineation of the Tolleson Area" (Dibble & Associates, April 1999). In addition, the City of Tolleson has reported that street and intersection flooding occurs at specific locations along Van Buren Street and 91st Avenue.

However, this CAR primarily focuses on the portion of the floodplain associated with the railroad embankment between 83rd and 99th Avenues. This portion of the floodplain conveys a 100-year event of 944 to 978 cfs and negatively impacts approximately 30 acres of existing residential and industrial developments, within the City of Tolleson (Dibble & Associates, April 1999). This CAR also addresses the street and intersection flooding along both Van Buren Street and 91st Avenue.

Major Features & Any Limitations:

Within the Tolleson study area, there are no continuous man-made or natural watercourses. The major watercourses that are closest to the study area are the Salt and Agua Fria Rivers, which are approximately 3 miles from the study area. Hence, a major limitation is that there is not a continuous watercourse where drainage alternatives can outlet, within the study area.

The results of the recent floodplain delineation study (Dibble & Associates, April 1999) indicates that most of the storm water generated within the study area is currently conveyed to the Agua Fria River in a mostly unimproved floodplain along the north side of the UP/SPRR embankment. However, the capacity of the this floodplain to convey flow to the Agua Fria River is limited by existing developments that now contain the existing floodplain. In addition, a proposed golf course/drainage corridor within the City of Avondale is currently under design. This golf course/drainage corridor will extend one mile east from the Agua Fria River along north side of the UP/SPRR tracks. The proposed golf course/drainage corridor has a storm water design capacity of approximately 940 cfs, which corresponds to the computed 100 year peak flow rate for existing conditions.

Estimated Initial Cost:

The following is a brief description and a list of the conceptual cost estimates for each of the Alternatives and sub-alternatives evaluated and described in this CAR:

Alternative 1-A: Grass Lined Channel Systems	$10,968,000
Alternative 1-B: Hard Lined Channel Systems	$11,377,000
Alternative 1-C: Reduced Channel Sizes & Larger Retention Basins	$11,360,000
Alternative 1-D: Including the Retention Basin at the Proposed Park Site	$10,882,000
Alternative 2-A: Grass Lined Channel Systems	$6,820,000
Alternative 2-B: Hard lined Channel Systems	$6,940,000
Alternative 2-C: Reduced Channel Sizes & Larger Retention Basins	$7,477,000
Alternative 2-D: Including the Retention Basin at the Proposed Park Site	$6,700,000
Alternative 3: Do Nothing/Let Future Development Implement Facilities	$0

Listing of Probable Partners:

City of Tolleson
9555 West Van Buren Street
Tolleson, Arizona 85353
Business Phone: (602) 936-7111

City of Avondale
1211 South Fourth Street
Avondale, Arizona 85323
Business Phone: (602) 932-1909

Salt River Project
Water Engineering
Mail Station PAB106
Phoenix, AZ 85072
Business Phone: (602) 236-2902

Union Pacific Railroad
1416 Dodge Street
Omaha, NE 68179
Business Phone: (402) 997-3623

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, AZ 85009
Business Phone (602) 506-1501

Preferred Alternative & Brief Discussion of Other Alternatives:

The preferred or recommended alternative, **Alternative 1-D**, is an "environmentally friendly" or "Kinder and Gentler" (i.e. K&G) solution for the flooding issues in the study or project area. This alternative is intended to establish a regional drainage system that future development can link into, thereby, fostering a positive environment for the citizens within the City of Tolleson and for future development. An added benefit is that the City of Avondale also benefits from the regional drainage facilities proposed in Alternative 1-D.

The major components of the preferred alternative, Alternative 1-D, are:

- A channel along east side of 91st Avenue from Van Buren Street to UP/SPRR.
- A 60-inch storm drain system along Van Buren Street from 95th Avenue to 99th Avenue.
- A channel along 99th Avenue from Van Buren Street to the UP/SPRR.
- A greenbelt system including drainage improvements, optional recreational facilities, and optional light rail facilities, along the north side of the UP/SPRR from 83rd Avenue to a proposed golf course facility in the City of Avondale. The proposed golf course facility is currently under design by a private developer and will extend one mile east from Agua Fria River. The proposed golf course facilities have a storm water design capacity of 940 cfs, which corresponds to the existing 100-year event per the recent floodplain delineation study (Dibble & Associates, April 1999).
- Five (5) detention basins along UP/SPRR.
- Retention facilities at the proposed park site located at the southwest corner of 86th Avenue and Van Buren Street.

The preferred or recommended alternative is Alternative 1-D. However, **Alternative 1**, as a whole, includes several variations with optional components. In general, these optional components include: grass lined or hard lined channel systems at various locations, larger or smaller detention facilities, a retention basin facility at a proposed park site located at the southwest corner of 86th Avenue and Van Buren Street, and a joint-use retention basin facility within the City-owned Cowden Park.

Alternative 2 offers an option to reduce flooding area at a minimum construction cost by using storm drains, basins and channels at critical locations. The major components of the alternative are:

- A channel along the east side of 91st Avenue from Van Buren Street to the UP/SPRR.
- A 42-inch storm drain system along Van Buren Street to the City-owned Cowden Park.
- A new joint-use retention basin facility within the City-owned Cowden Park.
- A channel along the UP/SPRR from 91st Avenue to the proposed golf course in the City of Avondale.
- Three (3) detention basins along UP/SPRR.

Similar to Alternative 1, Alternative 2, as a whole, includes several variations with optional components. In general, these optional components include: grass lined or hard lined channel systems at various locations, larger or smaller detention facilities, a retention basin facility at a proposed park site located at the southwest corner of 86th Avenue and Van Buren Street, and a joint-use retention basin facility within City-owned Cowden Park.

Alternative 3 is a "do nothing alternative" that involves allowing future development to implement future drainage improvements that may positively impact the specific study areas addressed in this CAR. Recent development along the UP/SPRR embankment floodplain has involved construction of retention basins and/or channel systems to remove the proposed development from the FEMA floodplain.

Brief Recommendations:

It is important to note that the three alternatives described in this CAR are not mutually exclusive. That is, components of the three alternatives can be interchanged to build a unique regional drainage plan for the Tolleson area.

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1. INTRODUCTION / PROJECT BACKGROUND

1.1. Project Name / Title

Primatech, LLC was contracted by the Flood Control District of Maricopa County (District) to prepare the Candidate Assessment Report (CAR) for the Tolleson – Southern Pacific Railroad (SPRR) and Van Buren Street at 91st Avenue Drainage Improvement Project. The District's official project name and number is as follows: **Tolleson – SPRR and Van Buren Street at 91st Avenue FCD 98-23: PCN# 565-01-01**. It is important to note that the railroad tracts that extend through the project study area were previously operated by the Southern Pacific Railroad; however, the tracts now appear to be jointly operated by the Union Pacific and Southern Pacific Railroad (i.e. UP/SPRR).

1.2. Project Origination and Purpose

The District has defined that the purpose of the Candidate Assessment Report process is to analyze existing information and develop project data to serve as a planning tool for evaluation of projects, proposed by both outside agencies and the District, for inclusion into the Capital Improvement Program (CIP). Basic goals of the CAR process include identifying alternatives and evaluating funding requirements for potential projects.

The City of Tolleson submitted two project requests to the District. The following are brief descriptions of the project requests submitted by the City of Tolleson:

- "Van Buren Street Drainage" - Evaluation of intersection flooding along Van Buren Street in the Vicinity of 95th and 96th Avenues.
- "Southern Pacific Railroad Tracks Drainage Improvements" – Evaluation of potential flood control improvements to protect property owners located within the current FEMA floodplain that extends along the north side of the Southern Pacific Railroad (SPRR) tracks between 91st and 99th Avenues. The railroad tracts that extend through the project study area were previously operated by the Southern Pacific Railroad; however, the tracts currently appear to be operated jointly by the Union Pacific and Southern Pacific Railroad (i.e. UP/SPRR).

For purposes of this CAR, the two project requests submitted by the City of Tolleson will be addressed as one project. In addition, the scope of the Tolleson CAR was expanded to also include evaluation of drainage issues associated with 91st Avenue, between the I-10 Freeway and the UPRR tracks

The Tolleson CAR was conducted essentially prior to the commencement of the Durango Area Drainage Master Plan (ADMP). As a result, this study includes evaluation of conceptual regional drainage plans the Tolleson area. Therefore, it is anticipated that the conceptual regional drainage alternatives developed as part of this study will be considered by the project team preparing the Durango ADMP.

1.3. Location and General Description of the Project Area

The Tolleson project area is located south of Interstate 10 (I-10). It is in Township 1 North, Range 1 East, Sections 3, 4, 9, and 10, Arizona (see Figure 1-1 Vicinity Map and

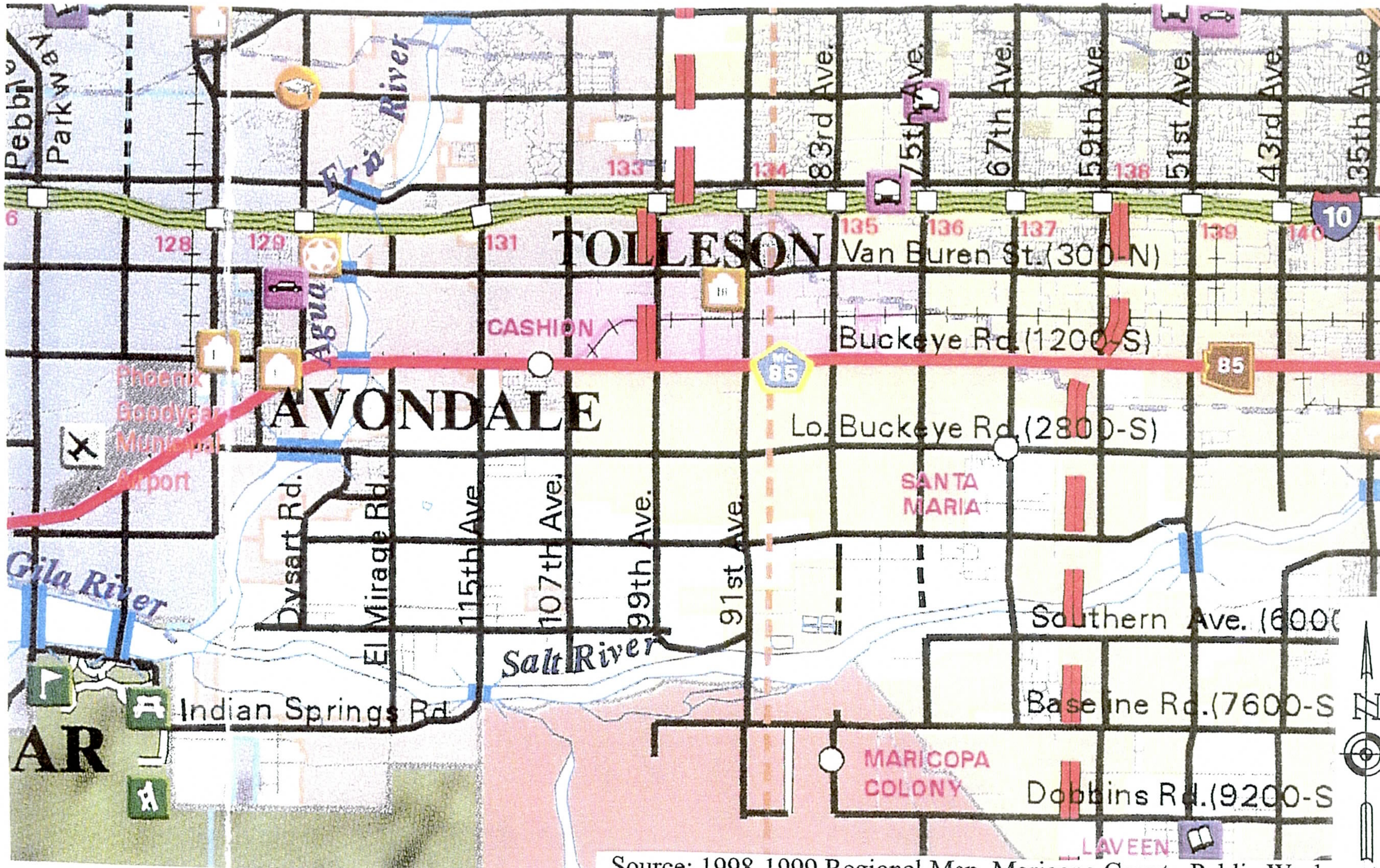
Figure 1-2 Project Area Map). The City of Tolleson comprises six square miles and is bound on the north, east, and south by the City of Phoenix. To its west, Tolleson abuts the City of Avondale, with Goodyear and Litchfield Park nearby. It lies 10 miles due west of downtown Phoenix and 13 miles west of Sky Harbor International Airport. The majority of Tolleson is situated between two major transportation corridors: I-10 and the UPRR.

As indicated in the City of Tolleson General Plan (Appendix E-6), it is anticipated that warehousing, distribution centers, and light industry will continue to locate near the railroad corridor. In addition, the current railroad alignment connects many of the greater Phoenix area cities, including Goodyear, Avondale, Tolleson, downtown Phoenix, Tempe and Mesa. The City of Tolleson has considered the feasibility of a passenger rail system.

The residential population of the City of Tolleson numbers approximately 4,500. The increasing urbanization and fast-growing populations of the western valley cities are expected to impact Tolleson. Projections by the Maricopa County Association of Governments foretells a quadrupling of the southwest metropolitan area's population over the next 25 years.

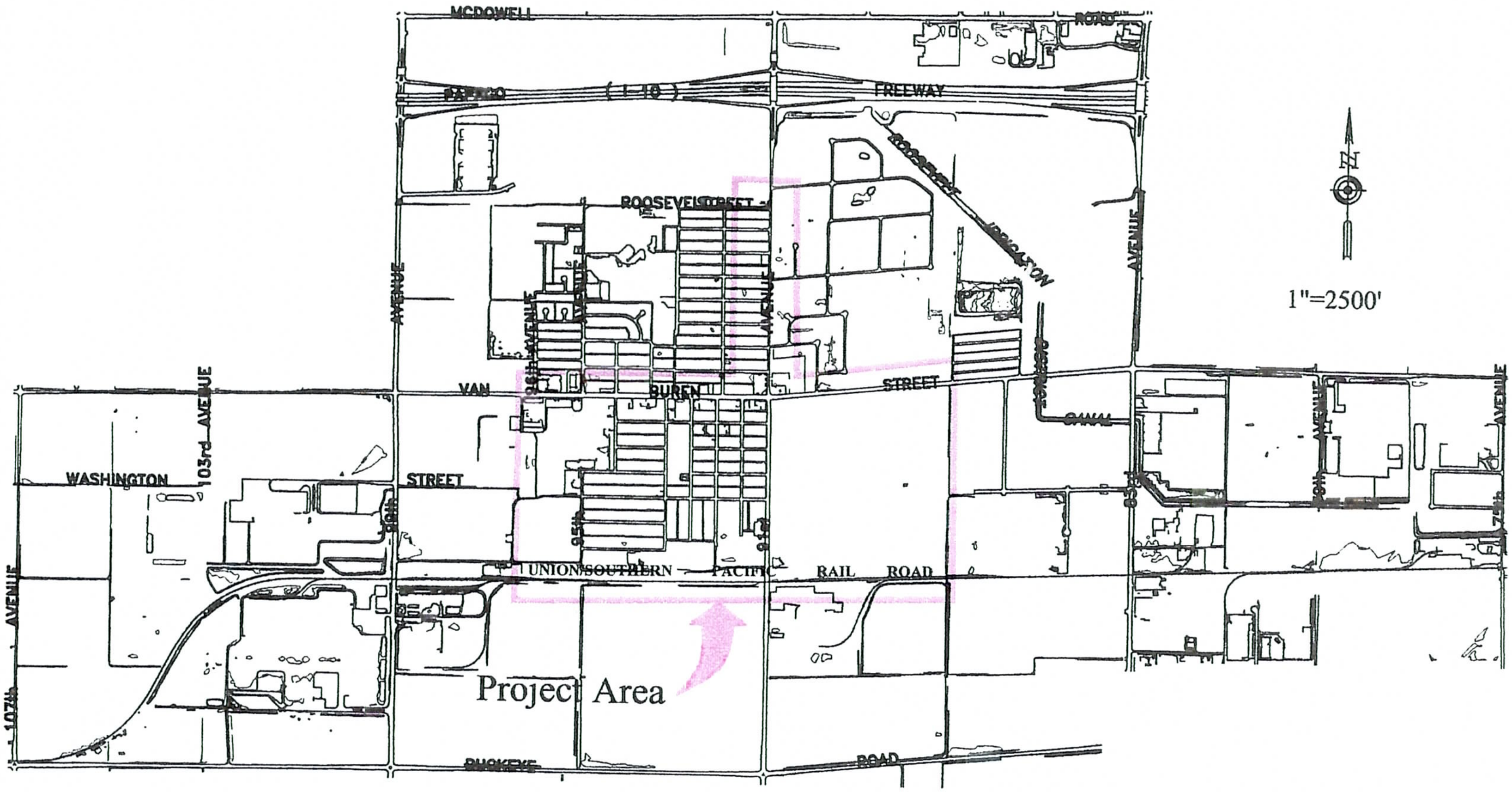
The Tolleson study area has the following geographic and climatic characteristics:

- The study area is at an average elevation of 1,025 feet.
- The study area has a general slope to the southwest of approximately 0.3%.
- The average annual rainfall within the study area is approximately seven (7) inches.
- The temperature ranges from 30°F to 70°F in the winter months, and from 80°F to 115°F in the summer months.
- Storm water originating within the study area drains to two major tributaries of the Gila River, the Agua Fria River and Salt River, which are located to the west and to the south of the Tolleson study area, respectively. The Agua Fria River is located approximately 2.5 miles west of Tolleson; while, the Salt River is located approximately three miles south of the Tolleson study area.
- The study area is bound on the north by the I-10 Freeway and corresponding channel system, which is located along the north side of the freeway alignment. The channel system collects and conveys storm water to the Agua Fria River.
- The Roosevelt Irrigation District (RID) Canal extends across the City of Tolleson from north to west, as indicated in Figure 1-1. The canal system embankment generally collects and directs storm water away from the study area.
- The RID Canal system conveys irrigation water to the City of Buckeye; whereas, the SRP irrigation system services the agriculture land in Tolleson. SRP irrigation facilities, including irrigation ditches and underground pipe systems, extend along most of the major streets and roads within the City of Tolleson.
- As indicated in Figure 1-1, the SP/UPRR embankment extends across the City of Tolleson from east to west. The railroad embankment generally collects and directs storm water to the west along the north side of the embankment.



Source: 1998-1999 Regional Map, Maricopa County Public Works

PRIMATECH ENGINEERS & CONSULTANTS	Tolleson - SPRR and Van Buren Street at 91st Avenue	FCD 98-23 PCN # 565-01-01
	Vicinity Map	Figure 1-1



PRIMATECH
ENGINEERS & CONSULTANTS

Tolleson - SPRR and Van Buren Street at 91st Avenue	FCD 98-23 PCN # 565-01-01
Project Area Map	Figure 1-2

1.4. *Drainage Problem Identification*

Two features that play a significant role in defining the drainage patterns in the study area are the RID Canal and the Union Pacific Southern Pacific Railroad (UP/SPRR). The RID Canal and the UP/SPRR embankments are primarily elevated within the study area. Roadways that cross these features typically rise to meet the elevated grade of the canal and railroad embankments. The railroad, canal, and roadway embankments collect storm water and form both ponding areas and relatively shallow floodplains. The floodplains associated with the canal, roadway, and railroad embankments in the Tolleson area have been delineated and documented in a report titled "Floodplain Delineation of the Tolleson Area" (Dibble & Associates, April 1999).

One exception to the drainage pattern described above occurs at the intersection of Van Buren Street and the RID Canal (see Photographs 1 and 2 – Appendix A). Van Buren Street crosses the RID Canal with a continuous slope from east to west. Hence, it is anticipated that Van Buren Street directly conveys storm water across the RID Canal, during major rainfall events.

This CAR primarily focuses on the portion of the floodplain associated with the railroad embankment between 83rd and 99th Avenues. This portion of the floodplain conveys a 100-year event of 944 to 978 cfs and negatively impacts approximately 30 acres of existing residential and industrial developments, within the City of Tolleson (Dibble & Associates, April 1999). This CAR also addresses the street and intersection flooding along both Van Buren Street and 91st Avenue, as reported by the City of Tolleson (Appendix E-2).

1.4.1. Drainage Along 91st Avenue

The study area of 91st Avenue is generally from I-10 to the UP/SPRR. The historic drainage patterns in the vicinity of 91st Avenue are generally in the northeast to southwest direction. Since the construction of I-10 in the middle 1980's, 91st Avenue crosses over I-10 via a bridge or overpass. Drainage facilities associated with the I-10 freeway include a major drainage channel that extends along the north side of the freeway from approximately 35th Avenue to the Agua Fria River. This drainage channel has a depth of approximately 15 feet, a topwidth of approximately 85 feet, and side slopes of approximately 2:1. This channel defines the northern limit of the Tolleson study area.

North of Van Buren Street

North of Van Buren Street, 91st Avenue has two drive lanes with a flat crown and is higher than the surrounding area, causing a north/south division in the watershed. There is no curb on either side of 91st Avenue, except for small sections of vertical curb in front of a small commercial center at the northwest corner of the intersection with Van Buren Street. Flows generated on and west of 91st Avenue continue to the southwest into the connecting streets. Flows generated east of 91st Avenue are collected by an SRP earthen irrigation ditch along the east side of 91st Avenue.

The tributary drainage areas that contribute to the existing conditions include the Tolsun Farms residential development. Tolsun Farms has been developed with fairly large irrigated lots. As such, the bermed lots will prevent runoff from the lots during medium storm events. Christa Way and Lillian Lane, which are the two longest east-west streets in the development and provide access to 91st Avenue, rise to meet the grade of 91st Avenue. However, at both Taylor Street and Lillian Lane, there are two small grates approximately 2'x2' in size attached to a 12-inch RCP pipe that directly drains storm water from the development into an SRP earthen irrigation ditch along the east side of 91st Avenue. A small concrete ditch attached to the earthen ditch is located north of Lillian Lane and extends into the residential development. This concrete ditch with a cross-section area of about 6 square feet can also drain small amount of storm water from Tolsun Farms.

The SRP earthen irrigation ditch along the east side of 91st Avenue has a top width of approximately 12 feet with a side slope of 1:2 (H:V) and a freeboard of 0.5 to 1 foot (see Photographs 3 and 4). Historically, the SRP irrigation ditch intercepts storm water conveyed or overflowing into it. However, according to the staff of the City of Tolleson, SRP has indicated a willingness to separate the storm water from the irrigation water and to discontinue accepting storm water into the irrigation ditches. Additionally, the City of Tolleson expressed a desire to underground the irrigation ditch along 91st Avenue.

South of Van Buren Street

South of Van Buren Street, 91st Avenue has four drive lanes with a center lane. There is vertical curb at the west side of the roadway (see Photographs 5 and 6). Flows to 91st Avenue south of Van Buren Street come from four areas: flow from 91st Avenue north of Van Buren Street, flow from Van Buren Street east of 91st Avenue, flow from the farm land east of 91st Avenue between Van Buren Street and the UP/SPRR tracks, and the flow generated on the roadway. There is one grate inlet at both of the northeast and northwest corners of the intersection of 91st Avenue with Van Buren Street (see Photographs 7 and 8), which drain the storm water to the nearby irrigation system according to the staff of the City. No as-built or other plan is available for the two catch basins. Due to the insufficient conveyance capacity of the roadway, the majority of flows will leave the 91st Avenue roadway and flow to the west within the connecting streets. The remainder will flow west from 91st Avenue and the UP/SPRR.

1.4.2. Drainage at Van Buren Street

Van Buren Street is the main street through the center of the City. It was the primary east-west artery from the state capitol in Phoenix before the construction of the interstate freeway network. Van Buren Street has four drive lanes with a center lane within the project area (see Photographs 9 and 10). According to the As-built dated November, 1974, the typical cross-section of Van Buren Street has a pavement of 36 feet for each side and a normal crown with a cross slope of 1.5%. There are vertical curbs on both sides of the street between 96th Avenue and 83rd Avenue.

East of 91st Avenue

In addition to the split flow from the ponding area east of the RID Canal, as stated in the beginning of the Section 1.4, other major flows that accumulate in Van Buren Street east of 91st Avenue include runoff from the residential developments of the Villa del Verde and Tolsun Farms. Retention basins have been observed along Van Buren Street south of Villa Rica Subdivision, between Villa del Verde and Tolsun Farms. According to a Final Drainage Study Report for the Villa Rica Subdivision, the retention basins are able to retain on-site and half-street off-site flows greater than the 100-year, 6-hour storm event required by Maricopa County (Reference 11).

There is no existing storm drain along Van Buren Street. The storm water exceeding the conveyance capacity of the street may split to the farmland south of the street.

West of 91st Avenue

The proposal of the City of Tolleson for Van Buren Street Drainage (Reference 4) provides a description of the ponding in the intersections of 95th and 96th Avenues with Van Buren Street during a storm. Runoff that accumulates in the intersections may come from upstream of Van Buren Street (east section), from 91st Avenue, and from the subdivisions north of the street. Lack of existing storm drains along the street and inadequate roadway slope cause inadequate conveyance capacity and ponding in the street. A dry well was observed at a low point of the intersection of 95th Avenue with Van Buren Street (Photographs 11 and 12). The City of Tolleson staff indicates that this dry well does not drain efficiently.

Pedestrian and traffic safety are issues when ponding occurs within the intersections. There are two schools located within one-half mile of these intersections. One school is located immediately across the street at 95th Avenue. School children utilize the sidewalks and crosswalks at these two intersections several times each day (Reference 4).

1.4.3. Floodplain along Southern Pacific Railroad

The drainage issues at the UP/SPRR are the floodplain and ponding along the north side of the railroad tracks, which travel from east to west through Tolleson. The floodplain extends nearly one-quarter mile north from the tracks in this area (see attached FIRM Maps and Appendix E-5 for the recent Floodplain Delineation Maps).

The 100-year floodplain that has been identified on the current FEMA Flood Insurance Rate maps and recent Flood Control District of Maricopa County floodplain delineation maps is caused by lack of drainage through the railroad embankment and/or lack of conveyance along the north side of the railroad tracks.

1.5. Federal Emergency Management Agency

FEMA data for the Tolleson area can be found on FEMA Flood Insurance Rate Maps Panel Number 0413C2105 D, Effective Date: April 15, 1988; and Panel Number 0413C2085 E, Map Revised: September 4, 1991. The floodplain north of the UP/SPRR is designated as Zone A0, which denotes areas of 100-year shallow flooding. The average depth of inundation in this area is two feet. The floodplain east of the RID Canal is designated as Zone A, which denotes areas of 100-year flood; base flood elevations and flood hazard factors not determined.

1.6. *Previous Hydrology and Floodplain Delineation Studies*

An area master drainage plan that includes the project area, titled *Durango Area Master Drainage Plan*, is in development and has not been completed at this time. The Durango Area Master Drainage Plan will represent the first regional plan that encompasses the CAR study area. However, digital topographic maps from the Maryvale Area Drainage Master Study were reviewed and used in the study of this CAR.

Existing data from the following two major reports of the floodplain delineation of the Tolleson area were reviewed in this project.

- Floodplain Delineation of the Tolleson Area, Hydrology Report, FCD Contract #95-26, prepared for the Flood Control District of Maricopa County by Dibble & Associates Consulting Engineers, May 14, 1999
- Floodplain Delineation of the Tolleson Area, Final Report and Technical Data Notebook, FCD Contract #95-26, prepared for the Flood Control District of Maricopa County by Dibble & Associates Consulting Engineers, May 1999.

The purpose of the "Floodplain Delineation of the Tolleson Area" was to prepare the hydrology and hydraulics to delineate areas of flooding due to conveyance and ponding behind the RID Canal and the UP/SPRR between 35th Avenue and El Mirage Road in the cities of Phoenix and Tolleson, Arizona.

Final Report

The Final Report of the "Floodplain Delineation of the Tolleson Area" documents the methodology and the hydrologic and hydraulic models used in the hydrology development and floodplain elevation determination. It revises and updates information on the existence and severity of flood hazards for the ponding areas upstream of the RID Canal and the UP/SPRR in west-central Maricopa County, Arizona.

Floodplain areas were delineated using the HEC-1 and HEC-RAS computer models. Ponding areas upstream of the UP/SPRR and RID Canal were modeled using HEC-1 routing subroutines. Hydrographs generated in the HEC-1 model were routed through ponding areas. Storage-elevation relationships for each ponding area were estimated using the District digital terrain model (DTM). Outflow from ponding areas was modeled using an irregular weir program and surveyed profiles of weirs that contained the ponding areas. Where outflow from the ponding areas is not controlled by weir flow, water surface elevations were modeled using the HEC-RAS model. Riverine-type flow between adjacent ponding areas was also modeled using HEC-RAS. Flow between ponding areas consists of low velocity discharge, urban sheet flow, and ineffective flow. Therefore, no floodways were delineated in the flood-prone areas modeled using HEC-RAS. Topographic data for HEC-RAS modeling was obtained from the District DTM (Reference 2).

Two types of flood-prone areas were identified for the Tolleson Area: 1) ponding reaches, and 2) riverine-like floodplain reaches. The RID Canal and the UP/SPRR grade are two main obstructions causing ponding within the study area. The RID Canal flows pass under I-10 one-quarter mile east of 91st Avenue and run into the study area, then turn to the southeast along an irregular alignment until they run east from about 59th Avenue to 35th Avenue. The UP/SPRR crosses the study area along an east-west alignment from I-17 to the Agua Fria River. Ponding area reaches mapped for this study is the area upstream of the UP/SPRR between 69th Avenue and the Agua Fria River.

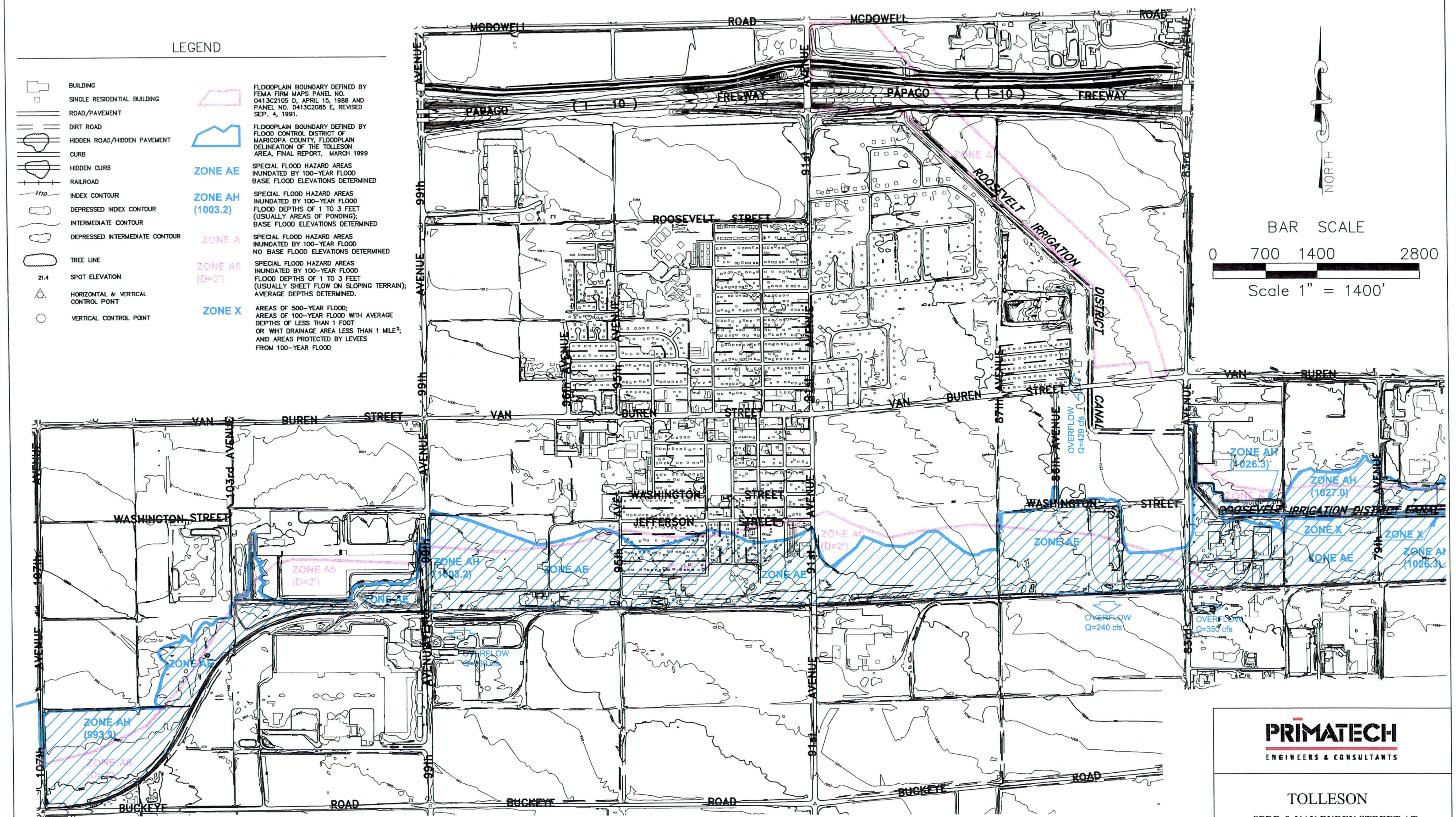
Within the project area of the Tolleson CAR, overflow over the RID Canal at a location approximately 600 feet south of Van Buren Street was identified in the Final Report with an overflow rate of 417 cfs. Two overflow locations along the UP/SPRR between 83rd Avenue and 107th Avenue were identified in this report. One overflow location is the northwest corner of 84th Avenue and the UP/SPRR with an overflow rate of 239 cfs. Another overflow location is the northeast corner of 99th Avenue and the UP/SPRR with an overflow rate of 358 cfs.

Figure 1-3 shows the floodplain area delineated in the study within the Tolleson CAR project area compared with the FEMA Floodplain. There is no floodplain along the RID Canal is delineated in the Final Report since the 100-year flood depth is less than one foot. There are three types of flood zones identified in the area along the UP/SPRR in the Final Report: Zone AE, Zone AH, and Zone X. According to the FEMA definition, both Zone AE and Zone AH are special flood hazard areas inundated by 100-year flood. The base flood elevations have been determined (see Appendix E-4: Excerpts from Floodplain Delineation of the Tolleson Area – Final Report and Technical Data Notebook, for the flood elevations). Zone AH usually denotes areas of ponding with flood depths of 1 to 3 feet. There are small areas are within Flood area Zone X, which by FEMA definition are 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.

Hydrology Report

The Hydrology Report specifically described the hydrologic modeling procedures. It updated 53 square miles of watershed hydrology. The primary purpose of the hydrologic analysis was to provide runoff data for delineation of flood hazard areas upstream from the UP/SPRR and the RID Canal. Runoff was computed for the 100-year, 24-hour storm. The hydrology model was extended in the downstream direction beyond the UP/SPRR and RID Canal to provide a complete model to the Salt River or Gila River on the south and the Agua Fria River on the west. Hydrology for the Tolleson area was developed using the U.S. Army Corps of Engineers, *HEC-1 Flood Hydrograph Package* (HEC-1) computer program. The computer program *Drainage Design Menu System* (DDMS) developed by the Flood Control District of Maricopa County was used in the study. The Hydrology Report presented the resultant 100-year, 24-hour peak runoff generated in each sub-area and peak flow at each concentration point (see Appendix E-3: Excerpts from Floodplain Delineation of the Tolleson Area – Hydrology Report, for the Peak Discharge Summary Table).

Based on the Hydrology Report and the digital HEC-1 output file of the hydrologic modeling, an existing drainage pattern has been depicted for the Tolleson area in Figure 1-4, which shows the local runoff for each sub-area, the 100-year peak flow for each major concentration point and the peak flow routing along the streets or splitting to other directions.



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SPRR & VAN BUREN STREET AT 91ST AVENUE DRAINAGE IMPROVEMENT

FOR FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE 1-3: EXISTING FLOODPLAIN

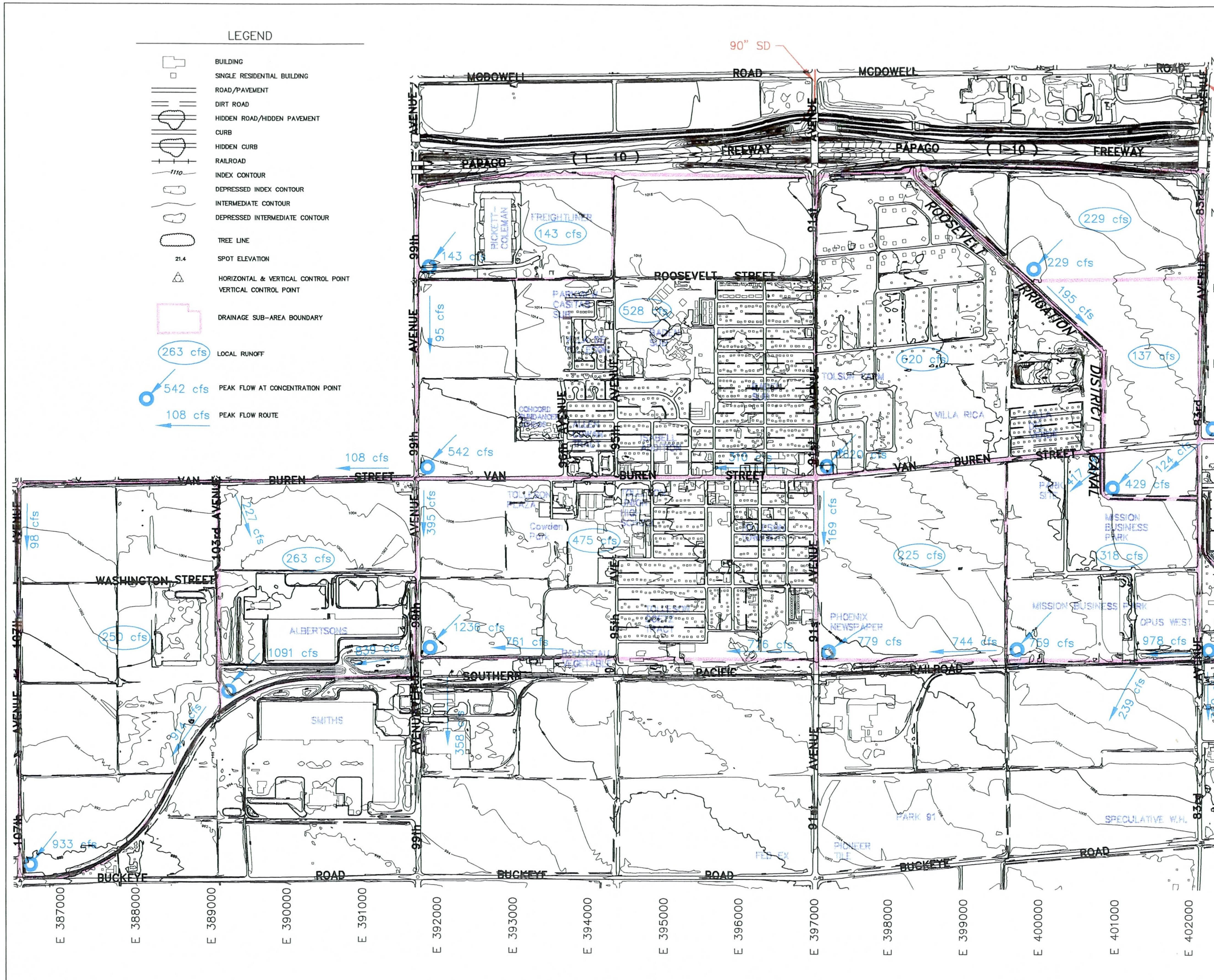

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FIGURE 1-4: EXISTING DRAINAGE PATTERN

1.7. *Summary of Existing Flooding Condition*

1.7.1. Floodplain along the UP/SPRR

Storm water runoff in the study area generally flows toward the southwest, following the natural topography of the watershed. The UP/SPRR embankment creates an obstruction to the southerly component of the natural runoff pattern. This obstruction diverts the runoff to the west parallel to the UP/SPRR embankment. North-south aligned roadways, irrigation ditches, and other topographic features interrupt the diverted westerly component of flow along the embankments and create ponding areas, so as to cause a serious flooding hazard in the project area.

Within each sub-basin upstream of the UP/SPRR, the depth of floodwater ponding behind the UP/SPRR is affected by several factors. The ponding depth is affected by the elevation of the UP/SPRR embankment on the south, the elevation of a roadway (or other type of) embankment to the west, the volume of floodwater delivered to the ponding area and the rate of overflow from each embankment. The floodplain widths are determined by the high water elevations. In the project area, it extends nearly one-quarter mile north from the tracks. Approximately 31 acres of existing residential area and some small industrial developments (see Photographs 13 and 14) are within the 100-year floodplain defined by the recent floodplain delineation study in the Tolleson area. One of the largest warehouse developments in Tolleson, Albertson's, has excavated huge retention basins south of it and embanked the building pad to excluded it from the floodplain.

According to the Hydrology Report of the Floodplain Delineation, the estimated 100-year peak flows along the floodplain north of the UP/SPRR are 978 cfs at 83rd Avenue, 744 cfs at 87th Avenue, 776 cfs at 91st Avenue, and 839 cfs at 99th Avenue (see Figure 1-4).

1.7.2. Impact of the Floodplain behind RID Canal

Although the RID Canal crossing through the northeast corner of the city prevents runoff from flowing into the high-density residential area north of Van Buren Street, it forms shallow floodplain east of the canal. A portion of the runoff that collected east of the canal will cross the canal and flow west via the roadway of Van Buren Street at the crossing. There is no grade breaks on the roadway in this section of Van Buren Street according to a field observation conducted during this study. Part of the runoff may continue along Van Buren Street or turn south on 91st Avenue and contribute to flooding at the downstream streets. After crossing Van Buren Street, the RID Canal turns east at a location approximately 600 feet south of Van Buren Street and one-quarter mile west of 83rd Avenue (see Photographs 33 and 34). According to the updated HEC-1 results of the Hydrology Report for the floodplain delineation, a majority of the runoff concentrated at the canal bend will spill over the canal with a peak flow rate of 417 cfs during a 100-year storm. This portion of runoff will finally contribute to the floodplain behind the UP/SPRR embankment.

1.7.3. Drainage Along 91st Avenue

According to the Hydrology Report, a peak flow of 620 cfs during a 100-year event will concentrate at the intersection of 91st Avenue and Van Buren Street (see Photograph

15). Of this peak flow, 310 cfs will travel west along Van Buren Street and 169 cfs will turn south on 91st Avenue. Due to inadequate conveyance capacity of 91st Avenue between Van Buren Street and the UP/SPRR, the majority of the flows that travel to 91st Avenue leave the roadway and flow west through connecting streets, which may cause flooding problems in these streets.

1.7.4. Ponding in Van Buren Street

The area that suffers a local flooding problem is located at the intersections of 95th Avenue and 96th Avenue with Van Buren Street. The estimated 100-year peak flow at these intersections is up to 400 cfs, which is far beyond the street conveyance capacity of Van Buren Street. The 100-year peak flow will cross the street crown and travel south into the adjacent streets. Since the Van Buren Street roadway is essentially uphill from the intersection with 96th Avenue, the storm water at the north gutter line may pond to a depth of one to two feet (Reference 4).

2. PROJECT INFORMATION / PROJECT CONSTRAINTS

2.1. Data Acquisition

The project team conducted an initial field reconnaissance visit to the project area with the staff of the Flood Control District of Maricopa County on March 20, 1999. Several additional site-specific field visits by individual members of the project team were conducted during March to June 1999. These field investigations and photographs taken at the site provided first-hand information for the drainage problem identification. Appendix A-1 is a Photographic Log of the Project Site prepared for the CAR.

In addition, various agencies were contacted for information, data, maps, as-builts, plans, published reports, and manuals during the study. The documentation obtained from the following sources are listed in Appendix A-2.

- Flood Control District of Maricopa County
- Maricopa County Department of Transportation
- Maricopa County Assessors Office
- City of Tolleson
- City of Avondale
- City of Phoenix
- Arizona Department of Water Resources
- Arizona Department of Transportation
- Roosevelt Irrigation District
- Salt River Project, Water
- Salt River Project, Power
- US West
- Southwest Gas Corporation

2.2. Jurisdictional Limits

The project area is located in the jurisdictional limit of the City of Tolleson, except for a number of county islands. According to the City Limit of Tolleson, Sheets 1 and 2, dated 1993 and 1990, along 91st Avenue, from Roosevelt Street to UP/SPRR, there are three county islands (see Figures 2-1 and 2-2):

- The east half of right-of-way of 91st Avenue of ±2.7 acres, between Van Buren Street and ±370 feet north of UP/SPRR.
- A 238'x8' strip located east of 91st Avenue, 147 feet north of Van Buren Street.
- A small area of 0.91 acres is located west of 91st Avenue, 291 feet south of Roosevelt Street.

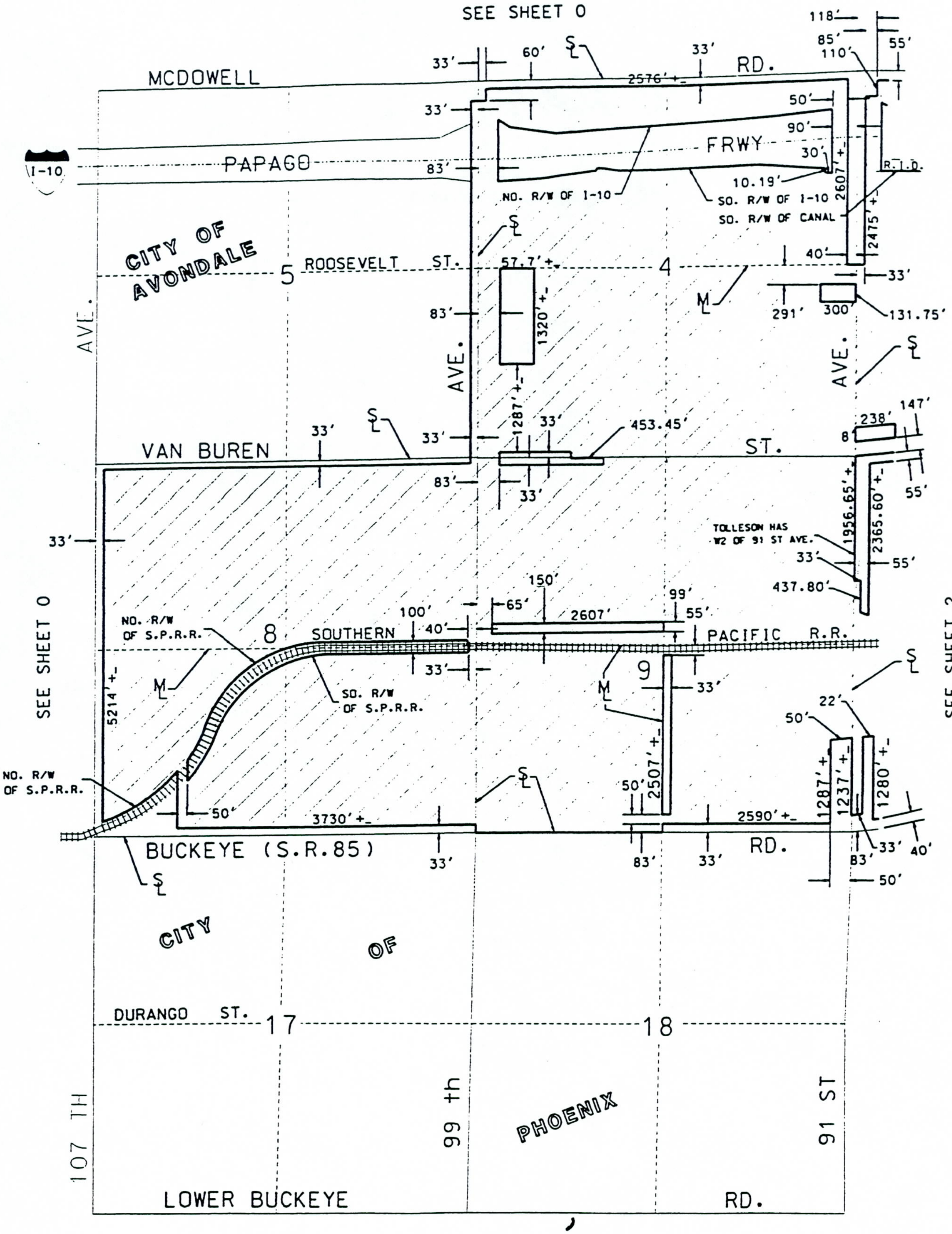


Figure 2-1 City Limit of Tolleson, Sheet 1

THIS CITY LIMIT SHEET IS TO BE USED AS A GUIDE ONLY! MARICOPA COUNTY WILL NOT BE RESPONSIBLE FOR ERRORS OR OMISSIONS THAT MIGHT OCCUR.

▨ · INCORPORATED AREA

TIN- RIE

TOLLESON

1

ORD NO	ANNEXATION EFF DATE	REV BY
237-NS	DEC. 27. 1984	KDO
312-NS	APRIL 12. 1991	R.N.
317-NS	DEC. 26. 1991	C.L.
325-NS	AUG. 27. 1993	C.L.

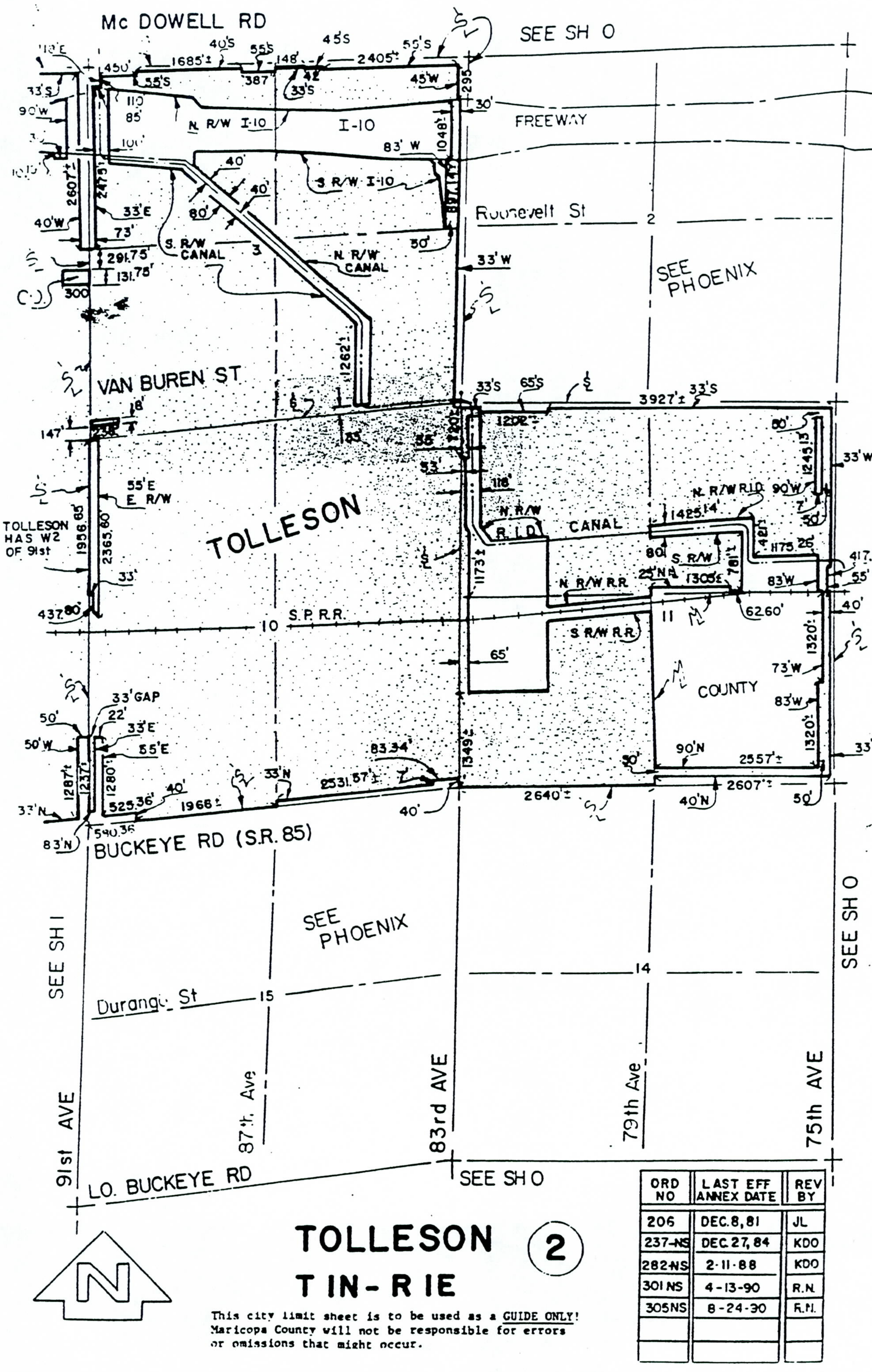


Figure 2-2 City Limit of Tolleson, Sheet 2

Other county islands within the City of Tolleson are not in the project area; however, they may be of interest for this project. These areas are:

- A 2607'x150' strip located between Harrison Street and the UP/SPRR, from 95th Avenue to 99th Avenue with an area of ± 9 acres.
- A part of the 33 foot right-of-way of Van Buren Street on both sides, 83 feet east of 99th Avenue (no adequate length information available about this area).
- The areas on both sides of the UP/SPRR between 83rd Avenue and 75th Avenue.

2.3. Existing Drainage Structures & Roadway Facilities

There are very limited existing drainage structures in the project area. Adequate retention basins can be found only in the residential subdivision, and industrial and commercial sites developed in recent years. The warehouse development of Albertson's has excavated huge retention basins of approximately 60 acre-feet in volume on the south side of the development and embanked the building pad to exclude it from the floodplain. Large retention basins have been observed along Van Buren Street south of the Villa Rica Subdivision. The total provided retention volume is 4.79 acre-feet according to a Final Drainage Study Report for the Villa Rica Subdivision. The retention basins are able to retain on-site and half-street off-site flows greater than the 100-year, 6-hour event (Reference 11).

Historically, the SRP irrigation ditches in the area intercepted and conveyed part of the storm water that topped the banks or was conveyed through minor storm drains to the ditches. However, according to staff of the City of Tolleson, SRP has indicated a willingness to separate the storm water from the irrigation water and to discontinue accepting storm water into the irrigation ditches.

Van Buren Street has two traffic lanes on each side of the street and a center lane with a total pavement width of 72 feet and typical cross slope of 1.5% in the project area. Vertical curbs are found on both sides of Van Buren Street from 83rd Avenue to 96th Avenue. There is a storm dry well installed at the intersection of 96th Avenue and Van Buren Street but, according to the staff of the City of Tolleson, it does not drain efficiently.

Ninety First Avenue, from I-10 to Van Buren Street, has only one lane on each side of the roadway and no center lane. From Van Buren Street to the UP/SPRR, 91st Avenue has two lanes on each side of the roadway and a center lane. There is no curb on the east side of 91st Avenue, while vertical curbs were found on the west side from Van Buren Street to the UP/SPRR and in front of a small commercial center at the northwest corner of Van Buren Street and 91st Avenue. The storm water conveyance capacity is very limited. There are two grate inlets at the northeast corner and northwest corner of the intersection of 91st Avenue with Van Buren Street, which drain the storm water to the nearby irrigation system. There is also a small grate inlet noticed in 83rd Avenue north of Washington Street. No as-built plans are available for these inlets.

Only two hydraulic structures were identified within the study limits along the UP/SPRR. First, there is a 24-inch RCP culvert with a headwall located just east of Evergreen Vegetable, Inc. west of 91st Avenue. This culvert is partially blocked with sediment, but appears to adequately convey small nuisance flows under the UP/SPRR. Second, there are 2-24" CSP under a railroad spur located west of 83rd Avenue. No as-built plans for any of the culverts were available, as noted in the Data Collection, Reference 3.

While the open channel portions of the RID Canal appear to have some available freeboard and excess capacity during normal flow conditions, most of the roadway crossings (culverts and bridges) do not (see Photograph 16). Many roadways and laterals cross the RID Canal with less than 0.5 foot of freeboard. The capacity available in the canal above the normal flow is minimal.

2.4. Irrigation Facilities

The RID Canal passes under I-10 near 91st Avenue and runs into the study area, then turns to the southeast along an irregular alignment until it runs east from about 59th Avenue to 35th Avenue as shown in the Roosevelt Irrigation District Map.

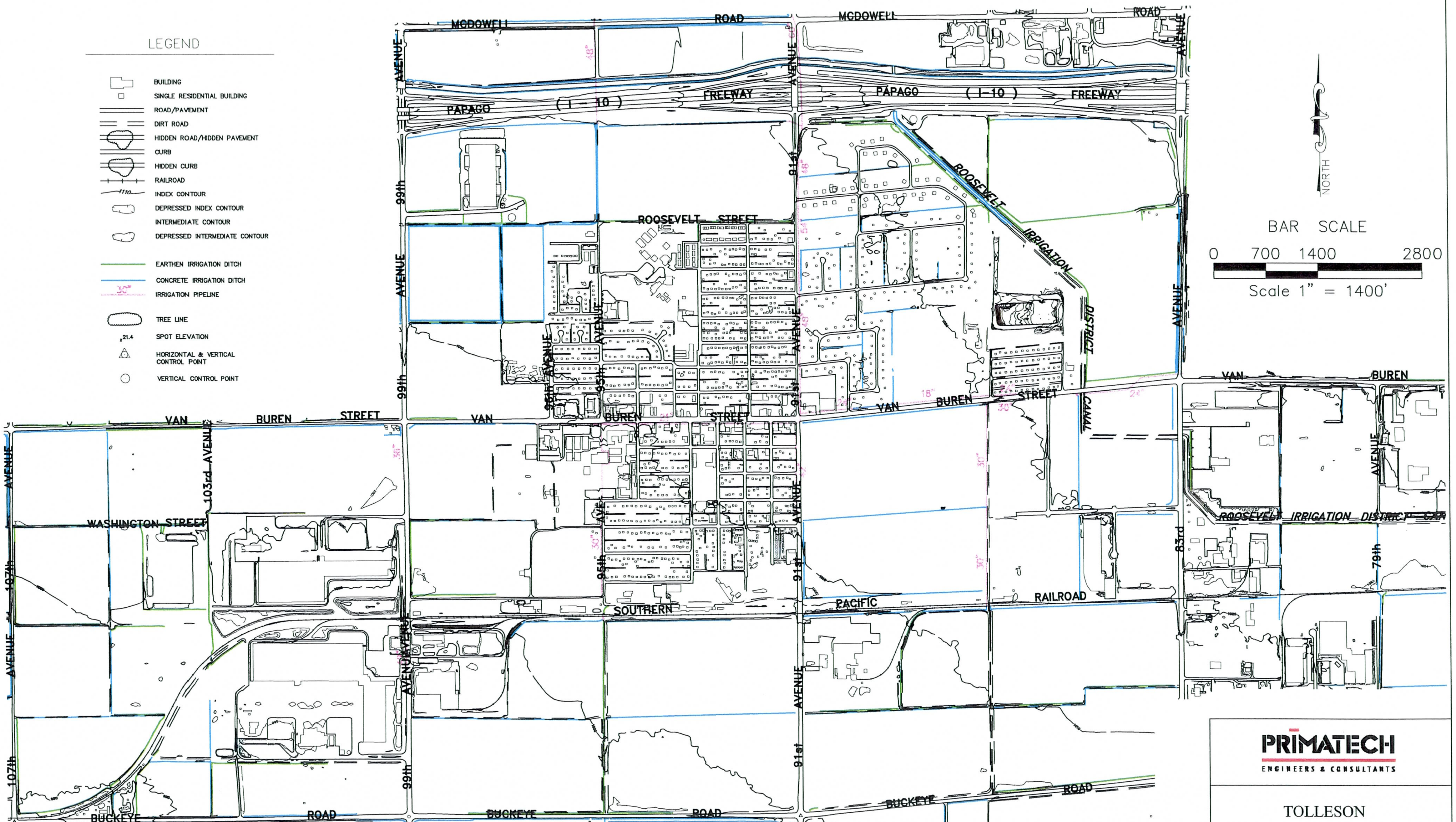
While the RID Canal conveys irrigation water to the town of Buckeye, an SRP irrigation system services the agriculture land in the City of Tolleson, which features irrigation ditches and underground irrigation facilities along most of the major streets and roads of Tolleson (see Figure 2-3,for approximate location of RID Canal and SRP Irrigation System and Photographs 3, 4, 17, 18 and 22).

2.5. Existing and Future Land Use

The City of Tolleson determined in its General Plan developed in 1996 that the key to Tolleson's unique character is the retention of its compact land use pattern. The City's early development centered on commercial activity along Van Buren Street with residential neighborhoods to the north and south. Homes are located within one-half mile of the Van Buren central business core. Schools, parks, recreation facilities, and government offices are also contained within this approximate one-half square mile of compact urban form west of 91st Avenue.

Existing land uses as of 1995 are shown in the Figure 2-4. As the City expanded, new residential areas developed to the east within the one-half mile radius of Van Buren Street. Major industrial employment centers located one-half mile to two miles south, east, and west of the Van Buren central business core. Many large parcels of land are currently in agricultural use or undeveloped. While residential land uses increased in area approximately 3% over the past 15 years, the largest growth in land use was in industrial and commercial areas. Industrial and commercial uses, including warehouse, distribution, manufacturing, retail, restaurants, and lodging, more than doubled during the same period. The commercial uses are located on McDowell Road between 83rd and 91st Avenues, and along Van Buren Street between 91st and 96th Avenues. A variety of industrial uses, including automotive, agri-related, and manufacturing businesses, now occupy most of Tolleson's eastern square mile, bound by Van Buren Street, 75th Avenue, Buckeye Road, and 83rd Avenue. Tolleson's western section between 107th and 99th Avenues is approaching 50% occupancy by industrial users, predominantly Smiths, Albertson's, and Power Packaging (Snapple). Lisanti is located at 104th Avenue and Van Buren Street near the first of four warehouses/distribution buildings by the Mack Company.

The City of Tolleson guides its land uses through a City of Tolleson Zoning Map (Figure 2-5) generated in August 1997 and Zoning Ordinance of the City of Tolleson developed



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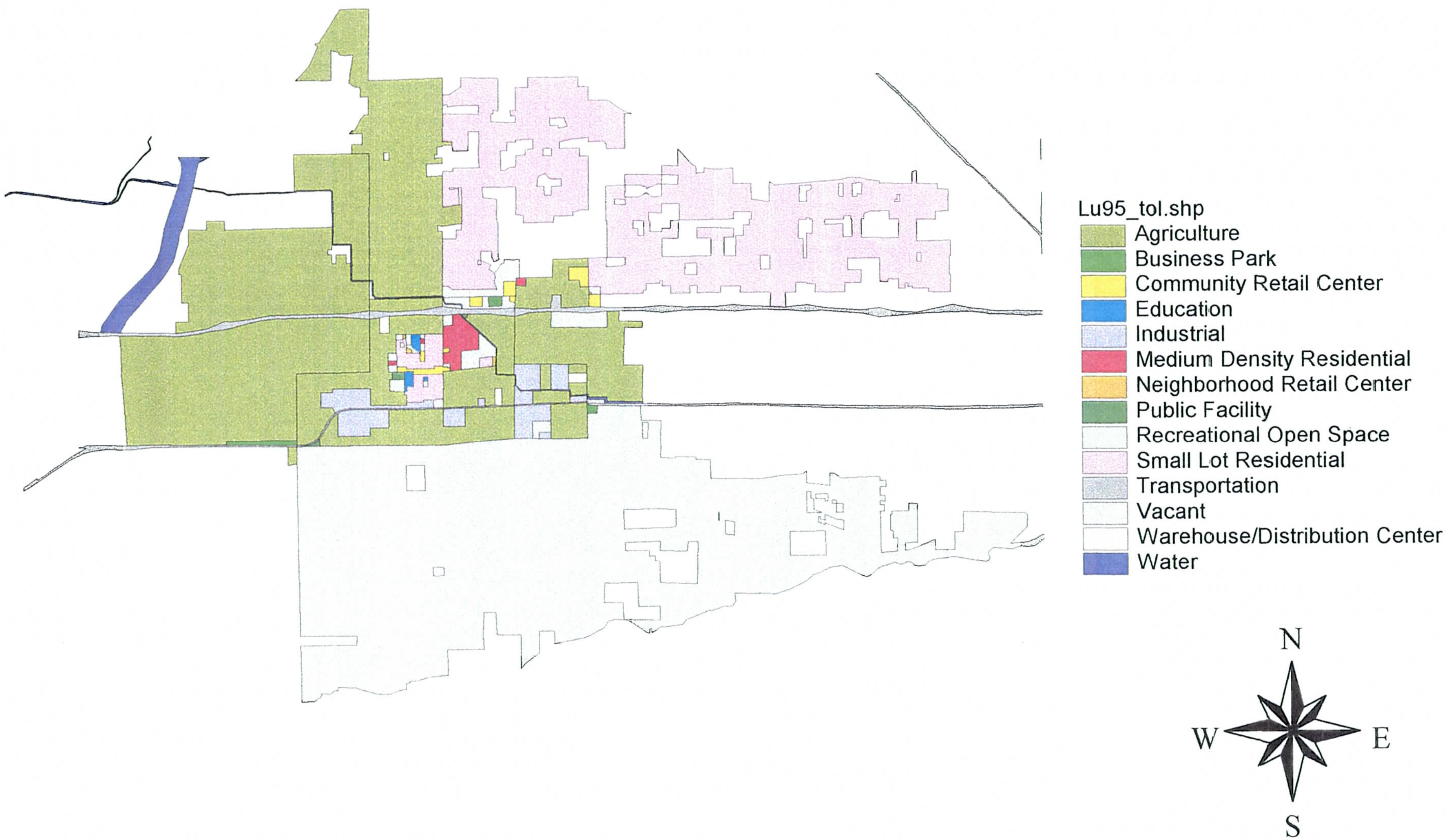
FOR FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE 2-3: RID CANAL AND SRP IRRIGATION SYSTEM

Figure 2-4 City of Tolleson Existing Land Use Map -1995



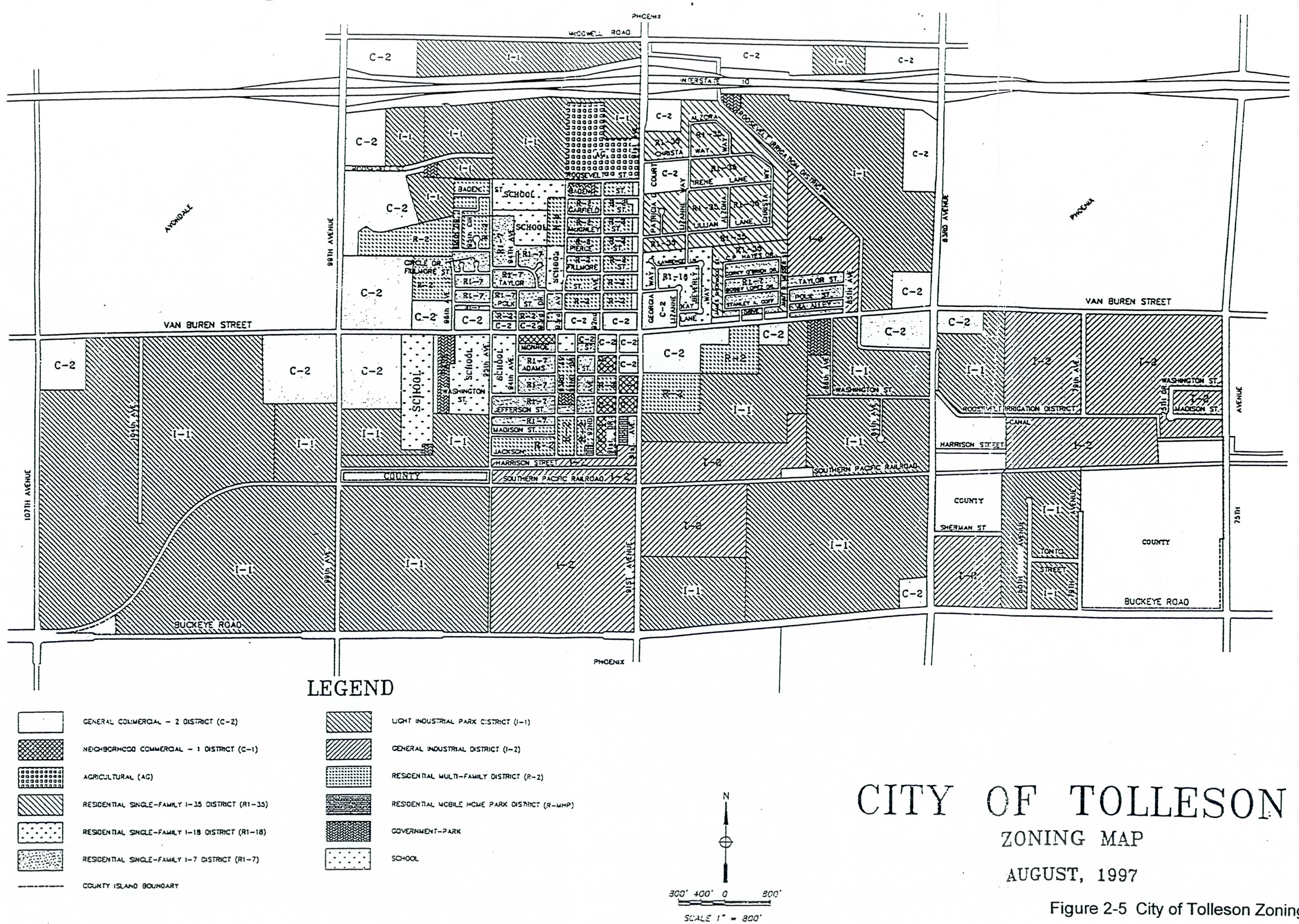


Figure 2-5 City of Tolleson Zoning Map

in 1987. Tolleson is continuing to enhance its sense of community through protection of existing neighborhoods and maintenance of its compact land use form in new developments. With incentives and buffering techniques, new residential areas will locate close to existing municipal services, schools, and recreational facilities. Commercial businesses, which provide for neighborhood needs, will expand the central business core. Tourist-related commercial uses and industrial employment centers will orient to the major transportation corridors in Tolleson.

Other larger areas zoned for commercial use include the southeast corner of 91st Avenue and Van Buren Street, the northwest and southwest corners of 83rd Avenue and Van Buren Street, the southwest corner of I-10 and 83rd Avenue, the south side of McDowell Road east of 91st Avenue, the southeast corner of McDowell Road and 99th Avenue, and the east side of 99th Avenue south of I-10 to Van Buren Street.

Remaining undeveloped parcels, in both the eastern and western square miles south of Van Buren Street, are primarily proposed and zoned for industrial development. Other major industrial uses are located along the UP/SPRR between 99th Avenue and 83rd Avenue. These include Borden Creamette, Bay State Milling, and Sun Land Beef. North of the railroad, between 86th and 83rd Avenues, is the Mission Business Park. Price/Costco and Stone Container are major tenants of the Mission Business Park. Remaining properties south of the railroad are proposed and zoned for industrial and commercial usage.

Almost one-half mile north of Van Buren Street, between 99th and 95th Avenues, industrial use has begun with the Rickett-Coleman Company located on Roosevelt, east of 99th Avenue. Over 70 acres are available for industrial development between the I-10 freeway and Pierce Street in this area. Additionally, land on the south side of McDowell Road, running west approximately three-quarters of a mile from 91st Avenue, is zoned for industrial use. Parker-Hanniflin Fuel Products Division is located on McDowell Road about one-half mile west of 83rd Avenue. Land on the west side of 83rd Avenue, between I-10 and Van Buren Street to the Tolsun Farms Subdivision, is also zoned for industrial usage. A future land use map is shown in Figure 2-6. It is the goal of City of Tolleson to maintain Tolleson's sense of community through the continuation of compact land use patterns with quality development and buffering.

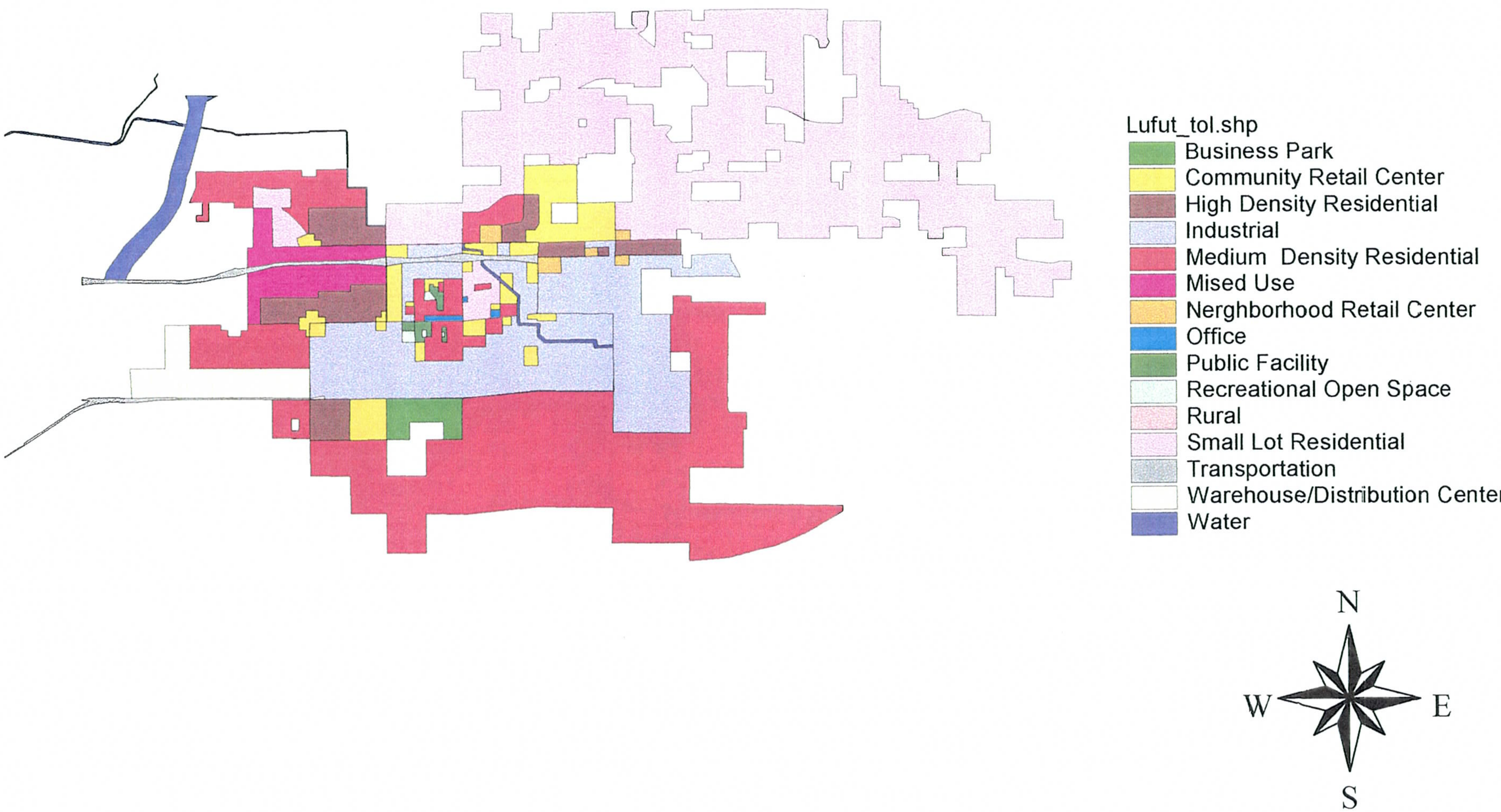
2.6. Right-of-Way

No right-of-way map is available for the project area from either the City of Tolleson or City of Phoenix. The right-of-way information prepared for this project is based on the Assessor's Map from the Maricopa County Assessor's Office and some other information such as the City Limit Sheets of Tolleson.

Figure 2-7 shows the right-of-way of 91st Avenue. North of Van Buren, the existing right-of-way of 91st Avenue is 33 feet wide on the west side and varies between 33 feet and 55 feet on the east side, both measured from the section line. South of Van Buren Street, the existing right-of-way of 91st Avenue varies from 47.8 feet to 39.97 feet on the west side, and is 55 feet on the east side except for a section from Harrison Street to the UP/SPRR, which is 65 feet on the east side.

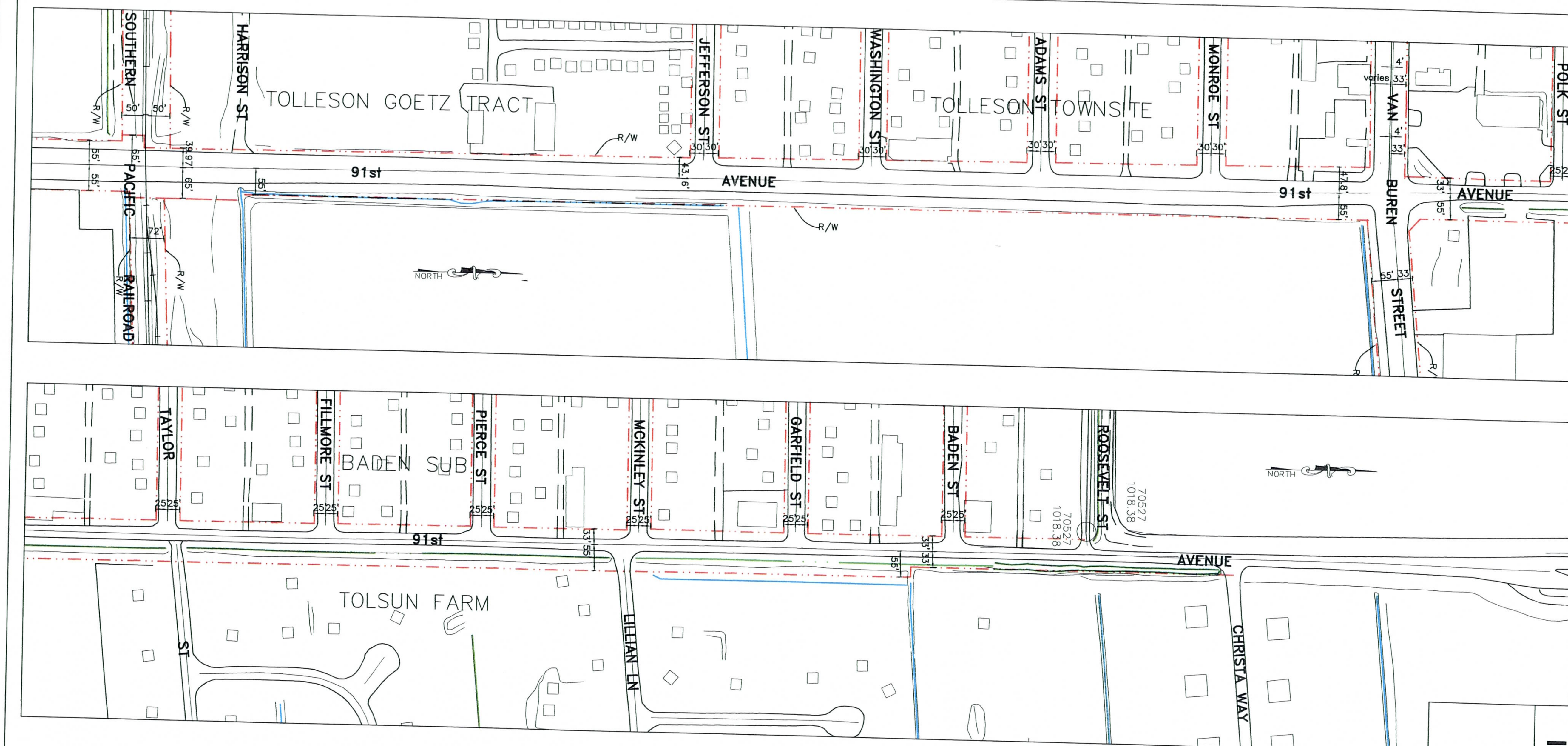
The existing right-of-way of Van Buren Street varies on both sides from 33 feet to 55 feet in the project area (see Figure 2-8 for detailed information of the right-of-way).

Figure 2-6 City of Tolleson Future Land Use Map



The existing right-of-way of 99th Avenue is 55 feet wide on the east side from Van Buren Street to Harrison Street, and 65 feet wide on the east side from Harrison Street to the UP/SPRR as shown in Figure 2-9.

Figures 2-10 and 2-11 show the right-of-way of the UP/SPRR in the Tolleson area from 107th Avenue to 83rd Avenue. From 107th Avenue to 99th Avenue, the typical existing right-of-way of the UP/SPRR is 50 feet on each side of the alignment line of the tracks. From 99th Avenue to 95th Avenue, the typical existing right-of-way is 50 feet on south side and 49.5 feet on north side. From 95th Avenue to 91st Avenue, the typical existing right-of-way of the UP/SPRR is 50 feet on each side. From 95th Avenue to 83rd Avenue, the typical existing right-of-way of the UP/SPRR is 72 feet in total width. The right-of-way of the UP/SPRR varies at some local locations where spur tracks exist.



LEGEND

BUILDING

SINGLE RESIDENTIAL BUILDING

ROAD/PAVEMENT

DIRT ROAD

HIDDEN ROAD/HIDDEN PAVEMENT

CURB

HIDDEN CURB

RAILROAD

WASH/ DRAINAGE/WATERLINE

EARTHEN IRRIGATION DITCH

CONCRETE IRRIGATION DITCH

RIGHT-OF-WAY

HORIZONTAL & VERTICAL CONTROL POINT

VERTICAL CONTROL POINT

BAR SCALE

0 100 200 400

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SPRR & VAN BUREN STREET AT
91ST AVENUE DRAINAGE IMPROVEMENT

FOR FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY

FIGURE 2-7
RIGHT-OF-WAY
91ST AVENUE

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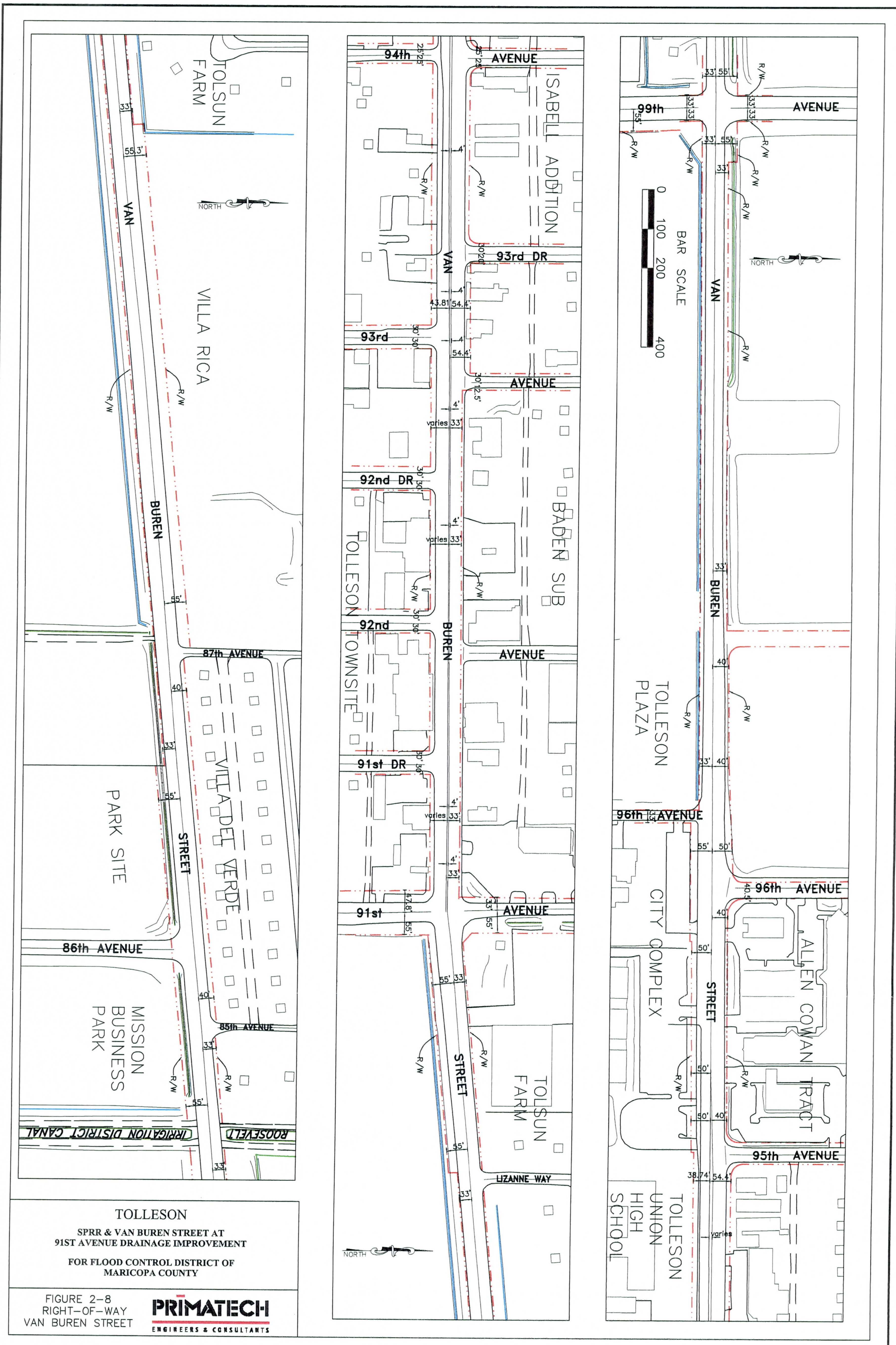

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SPRR & VAN BUREN STREET AT
91ST AVENUE DRAINAGE IMPROVEMENT

FOR FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY

FIGURE 2–8
RIGHT–OF–WAY
VAN BUREN STREET

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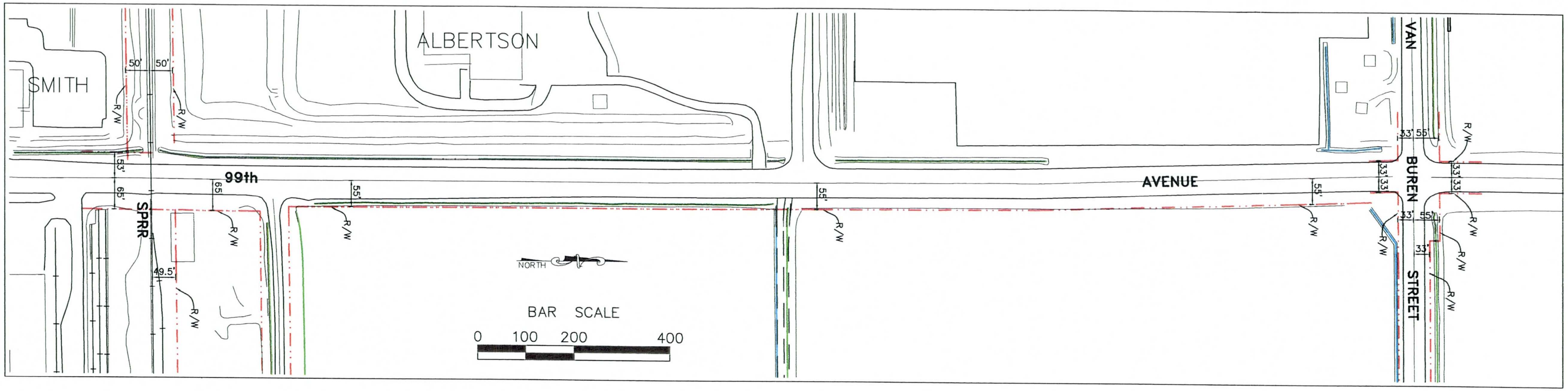

LEGEND

- BUILDING
- SINGLE RESIDENTIAL BUILDING
- ROAD/PAVEMENT
- DIRT ROAD
- HIDDEN ROAD/HIDDEN PAVEMENT
- CURB
- HIDDEN CURB
- RAILROAD
- WASH/ DRAINAGE/WATERLINE
- EARTHEN IRRIGATION DITCH
- CONCRETE IRRIGATION DITCH
- RIGHT-OF-WAY
- HORIZONTAL & VERTICAL CONTROL POINT
- VERTICAL CONTROL POINT

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SPRR & VAN BUREN STREET AT
91ST AVENUE DRAINAGE IMPROVEMENT
FOR FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY

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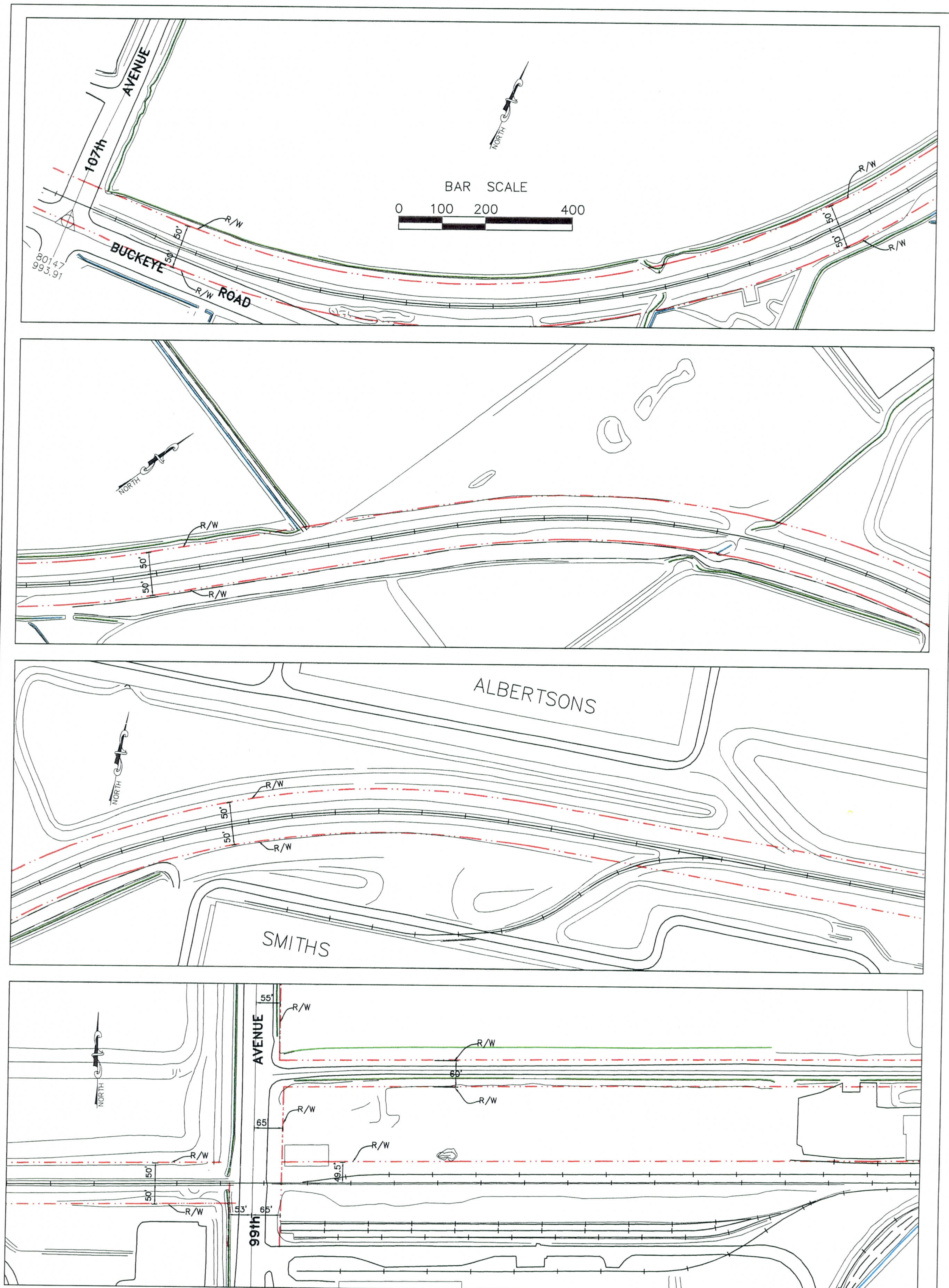
FIGURE 2-9
RIGHT-OF-WAY
99TH AVENUE



LEGEND

BUILDING
SINGLE RESIDENTIAL BUILDING
ROAD/PAVEMENT
DIRT ROAD
HIDDEN ROAD/HIDDEN PAVEMENT
CURB
HIDDEN CURB
RAILROAD
WASH/ DRAINAGE/WATERLINE
EARTHEN IRRIGATION DITCH
CONCRETE IRRIGATION DITCH
RIGHT-OF-WAY
HORIZONTAL & VERTICAL CONTROL POINT
VERTICAL CONTROL POINT

TOLLESON

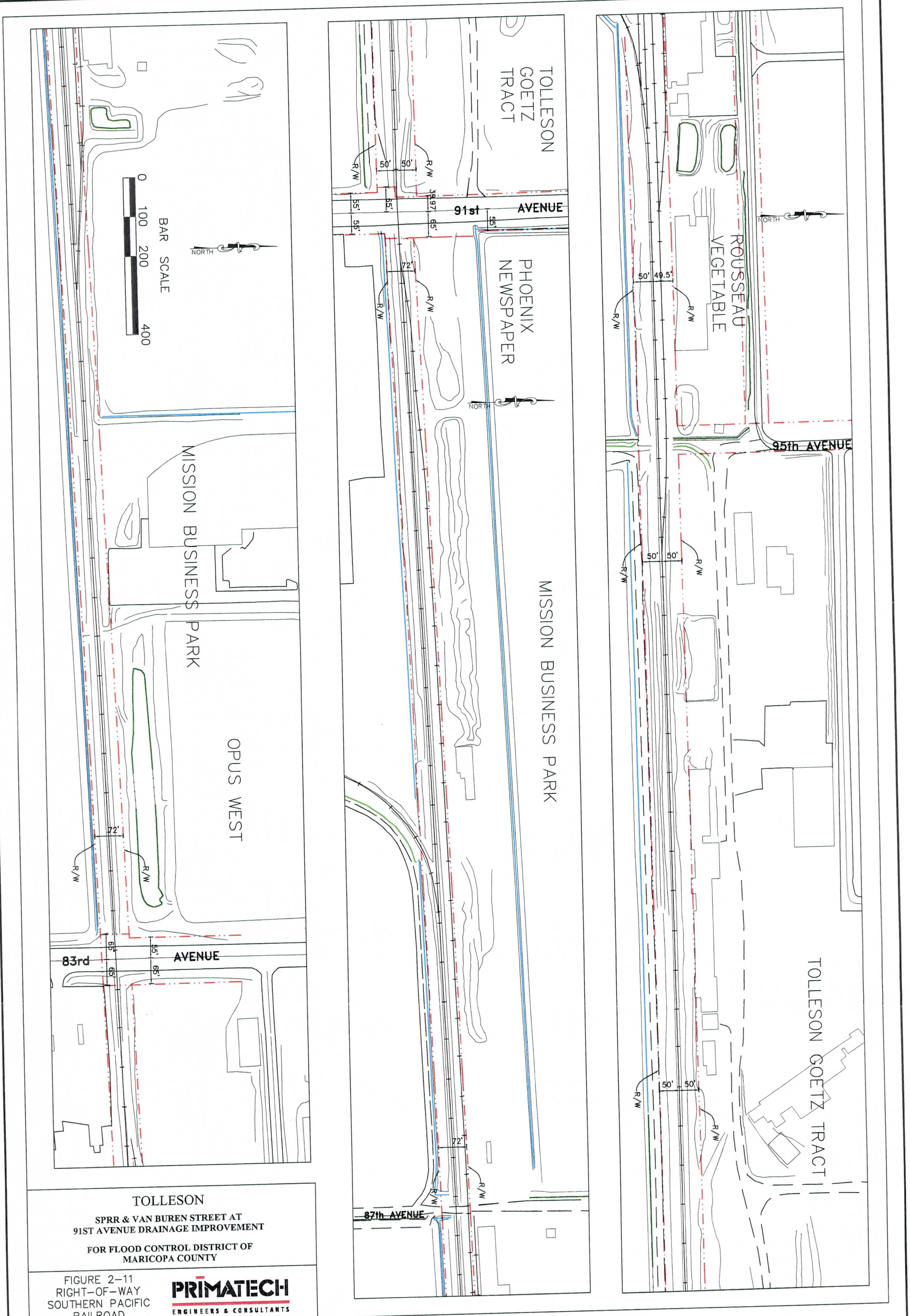
SPRR & VAN BUREN STREET AT
91ST AVENUE DRAINAGE IMPROVEMENT

FOR FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY

FIGURE 2-10
RIGHT-OF-WAY
SOUTHERN PACIFIC
RAILROAD

PRIMATECH
ENGINEERS & CONSULTANTS

\1prj\MFC019\ d\Drainage\ROW-SPRR6-18.dwg Wed Jul 07 21:44:35 1999 ATECH



TOLLESON

SPRR & VAN BUREN STREET AT 91ST AVENUE DRAINAGE IMPROVEMENT

FOR FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE 2-11
RIGHT-OF-WAY
SOUTHERN PACIFIC
RAILROAD

PRIMATECH
ENGINEERS & CONSULTANTS

2.7. *Existing Utilities*

Existing major utilities within the major drainage corridors of the evaluated alternatives in the studied area are shown in Utility Maps. The drainage corridors include 91st Avenue and 99th Avenue, from Van Buren Street to the UP/SPRR, Van Buren Street from 91st Avenue to 99th Avenue, and the UP/SPRR from 83rd Avenue to 99th Avenue. The public and private utility locations were obtained from quarter-section maps and as-builts provided as follows:

- Roosevelt Irrigation District – Irrigation Map
- Salt River Project – As-built Irrigation Facilities
- City of Tolleson – Water and Sewer
- Southwest Gas Corporation - Natural Gas Lines
- Salt River Project - Electric Power
- U.S. West Communications – Telephone

2.8. *Groundwater*

Groundwater information for the project area is based on the Arizona Department of Water Resources Hydrologic Map, Series Report Number 12, 1984. No updated report was available at the project time.

The groundwater depths in the Tolleson area range from 54 feet on the south to 102 feet on the north. The groundwater level rose above 50 feet in most of the Tolleson area from 1976 to 1983 caused by relatively abundant rainfall during the years and reduction of the groundwater uses.

Two numbers representing the groundwater quality are presented in the report. One is the specific conductance in micromhos per centimeter at 25°, which is an indication of the dissolved-solids concentration in water; and the second is the fluoride concentration in milligrams per liter. In the Tolleson area a sample from only one well north of Tolleson was collected and tested for quality. The specific conductance for the well was 1600 micromhos per centimeter at 25°, and the fluoride concentration was 0.4 milligrams per liter. Both numbers are relatively small compared to that of the wells in the surrounding area.

According to the staff of the City of Tolleson, the groundwater level in the Tolleson area is typically at a depth of approximately 90 feet, but varies from depths of ±70 to 100 feet. This is consistent with the ADWR report of 1984.

The City of Tolleson's General Plan (1996) indicates that has been concern over Tolleson's water quality being impacted by contamination of underground water found in the western area of Phoenix. The underground plume of chemical contaminants, such as PCE and TCE, appears to be flowing in a westerly direction. The City of Phoenix is limiting its groundwater usage and using SRP water and Central Arizona Project water from the Colorado River as a result. The Central Arizona Project water is not available to Tolleson as it lies wholly within the Salt River Project water franchise area. Tolleson is currently monitoring its wells and negotiating with the City of Phoenix for delivery of treated SRP water to Tolleson.

2.9. *Environmental Observations*

The project team conducted an initial field reconnaissance visit to the project area on March 20, 1999. Additional site visits were conducted by members of the project team between March and June of 1999. In addition, "environmental concerns or issues" were a topic of discussion with the City of Tolleson staff. Two environmental issues were identified:

- Existing storm water systems at the intersection of 92st Avenue and Van Buren Street outlet into existing SRP irrigation facilities. Future improvements in this area may need to remove storm drain connections to irrigation facilties.
- City of Tolleson staff indicated that there may be a 0.5 acre area with contaminated soil in the vicinity of the northeast corner of 99th Avenue and Harrison Street.

Further investigation of these environmental issues is recommended.

2.10. *Traffic Accident Reports*

To evaluate the potential hazards to public safety posed by the existing drainage condition adjacent to the roadways, traffic accident data was obtained from City of Tolleson. Within the Tolleson area, there were approximately 570 accidents that occurred within the last 5 years, excluding those that occurred on the I-10 freeway. Since no specific locations and causes were given, the accident data was deemed inconclusive.

2.11. *Section 404 Permitting*

Construction activities that impact waters of the United States, as defined in Section 404 of the Clean Water Act, will typically require a Section 404 Permit and a Section 401 Water Quality Certification. The U.S. Army Corps of Engineers (Corps) administers the Section 404 program in Arizona and the Arizona Department of Environmental Quality (ADEQ) administers the Section 401 program. Within the project area, there are no existing major washes or drainage channel systems. The only waterways that may potentially be Section 404 jurisdictional areas are irrigation tailwater ditches associated with the SRP irrigation system. This irrigation system is comprised of earthen ditches, concrete ditches, and underground pipes.

3. FUTURE TOLLESON PROJECTS & ONGOING PRIVATE DEVELOPMENT

3.1. *Future Transportation Plan*

BRW Inc. prepared the *Southwest Valley Transportation Study – Final Report and Appendix A* in April 1997 for the Maricopa County Department of Transportation. In this final report, the number of lanes for major streets in the southwest valley has been proposed for the five-year projects and the year 2001, for the ten-year projects and the year 2006, and for the 25-year projects and the year 2020. These projects were proposed based on an estimation of Average Daily Traffic for the proposed years. The proposed five-year project in the Tolleson area that includes a four-lane expansion plan for 91st Avenue, from McDowell Road to Van Buren Street, is shown in Figure 3-1. See Appendix E-7 for Excerpts from Southwest Valley Transportation Study – Final Report and Appendix A for other proposed plans in the vicinity of the project area.

As indicated in the General Plan, the City of Tolleson intends to establish 91st Avenue as the "Tolleson Downtown Center/Visitor Information" exit. Where as, the City intends to specify or designate 83rd and 99th Avenues as truck routes, as indicated in the General Plan. The City of Tolleson also plans to acquire right-of-way from the UP/SPRR and others to complete Harrison Street between 83rd Avenue and 99th Avenue, install a continuous right-turn lane westbound onto Harrison Street from 83rd Avenue, and install a continuous right-turn lane northbound onto 99th Avenue from Harrison Street. The intention of these improvements is to facilitate industrial traffic.

3.2. Future 91st Avenue Improvements

According to staff and the General Plan of the City of Tolleson, Tolleson is evaluating the following alternatives for future 91st Avenue improvements:

- Add one center lane and resurface the existing roadway from I-10 to Van Buren Street, adding turning bays, curbs and gutters, screening walls, and sidewalks enhanced with landscaping (additional to existing trees) instead of widening it to four lanes.
- Install landscaped traffic calming devices on 91st Avenue (e.g., center medians, stop signs, and pedestrian crossing safety islands and crosswalks) at five locations: 1) just south of I-10 at Christa Way, 2) at McKinley/Lillian, 3) at Taylor Street, 4) at Van Buren Street, and 5) just north of Harrison Street (see Figure 3-2).
- Underground the SRP irrigation canal along the 91st Avenue to eliminate pedestrian and traffic hazards.

3.3. Future Van Buren Street Improvements

In the General Plan, the City of Tolleson has explored a beautification alternative for Van Buren Street. That is to reinstall trees and landscaped center medians between 91st and 99th Avenues with parking and turning bays as needed; and continue landscaped median/parking east to 83rd Avenue. Figure 3-3 is from the General Plan of Tolleson, which illustrates an example of the landscaped median.

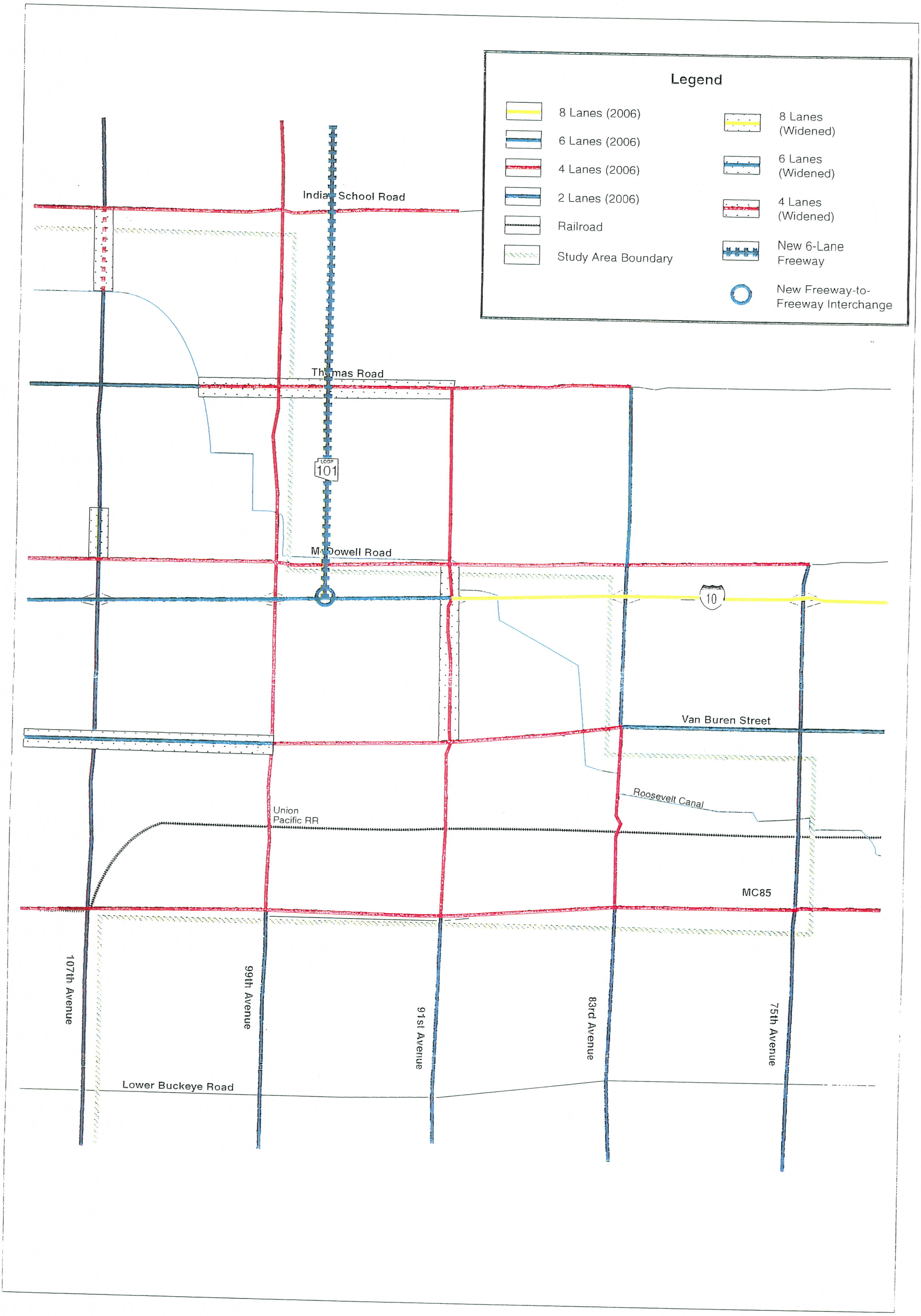


Figure 3-1 Future Transportation Projects

Source: BRW, Inc., 23 May 1996.

Southwest Valley Transportation Study

Tolleson Study Area: Five-Year Projects and Year 2001 Proposed Number of Lanes

Partners for Strategic Action

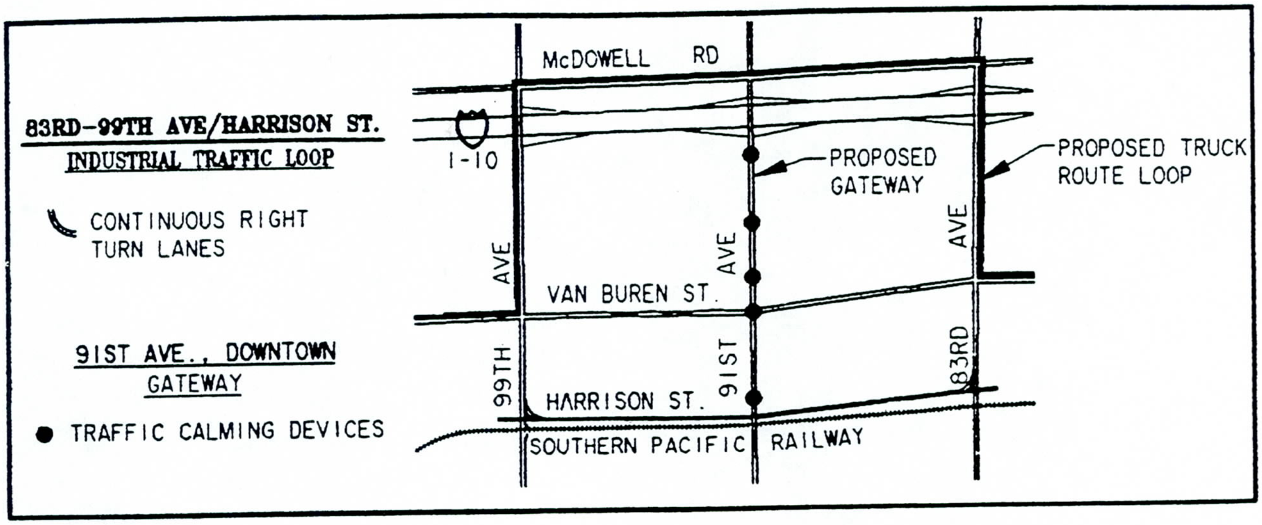


Figure 3-2 Future 91st Avenue Improvement

(Source: City of Tolleson, General Plan)

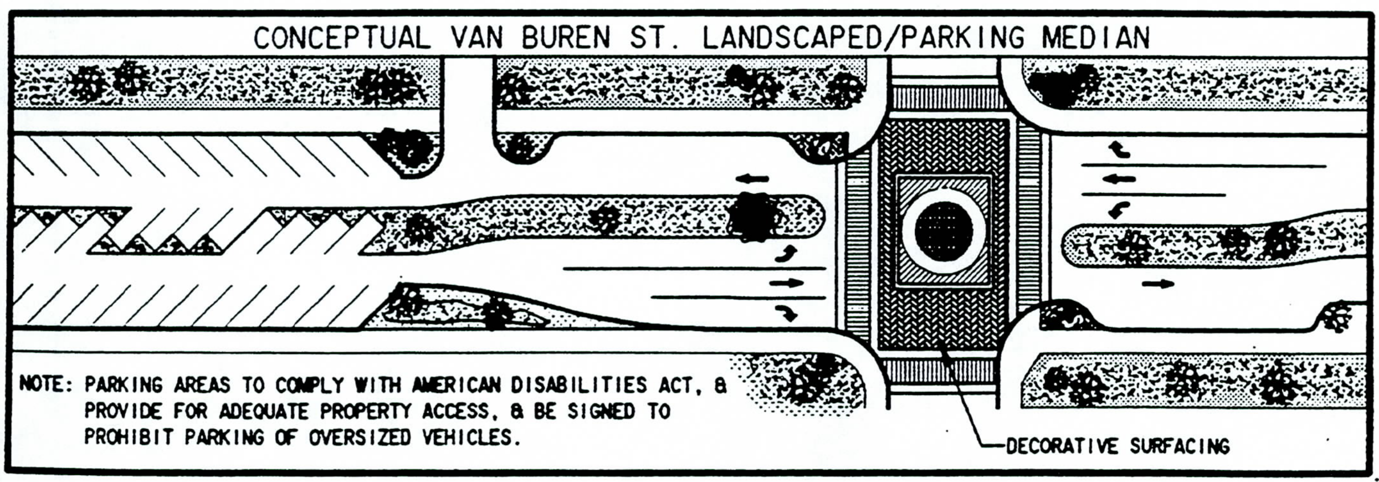


Figure 3-3 Future Van Buren Street Improvement

(Source: City of Tolleson, General Plan)

3.4. *Future Passenger Rail Service*

The UP/SPRR alignment connects many of the greater Phoenix area cities, some with former passenger depots. As indicated the City's General Plan, the City of Tolleson has considered as one of their strategies for its future to explore multi-use features of the railroad with Southern Pacific via an intergovernmental agreement among cities such as Goodyear, Avondale, Phoenix, Tempe, and Mesa. The multi-use features, including establishments of a winter season passenger rail service, would allow Tolleson and these cities to share in the economic benefits of tourism, transportation, and business development.

3.5. *Proposed Park*

The City of Tolleson owns a proposed park site south of Van Buren Street at 86th Avenue. It contains approximately 8.6 acres and is currently undeveloped. It is desired that a community fishing lake, picnic, and playground park be constructed at this site.

3.6. *Water and Sewer Lines under Construction*

Along the alignment of 94th Avenue from Van Buren Street to Buckeye Road, there are water and sewer lines under construction at the project time. The water line has a diameter of 12 inches and the sewer line varies in size from 12 inches to 18 inches.

3.7. *Ongoing Private Development*

During the last 15 years, the properties along the UP/SPRR and I-10 corridors have been developing with major businesses, primarily warehousing and light industry. The ongoing warehousing and industry development includes Freightliner at the northwest corner of 95th Avenue and Roosevelt Street, Phoenix Newspapers at the northeast corner of 91st Avenue and the UP/SPRR, and OPUS at the northwest corner of the 87th Avenue and the UP/SPRR. Although there are currently some vacant properties along the two prominent employment corridors, their prime locations ensure their future development. It is expected that more warehousing, distribution, and light industry will locate near the UP/SPRR corridor, taking advantage of its freight service. Other types of business development may also be suitable, resulting from their proximity to major transportation routes.

The City of Tolleson plans to encourage development of a golf course/hotel/restaurant facility along the freeway by providing incentives, such as surplus treated effluent. These freeway locations include 83rd or 91st Avenues.

In the City of Avondale, there is a proposed golf course development, which is located along the north side of the railroad tracks and extends one mile from Agua Fria River. The proposed golf course is 75 feet off the centerline of Buckeye Road and has a storm water design capacity of 941 cfs, according to staff of the City of Avondale.

4. IMPROVEMENT ALTERNATIVES

4.1. Evaluation Criteria & Primary Project Constraints

The following evaluation criteria has been used to evaluate and develop the alternatives:

- Potential benefits to the citizens with the City of Tolleson and adjacent communities
- Project feasibility and the limits of the benefited area
- Impact on FEMA floodplain areas
- Capital improvement costs
- The potential for construction phasing
- Environmental Concerns and permitting requirements
- Maintenance requirements, both short and long term
- "Public Involvement" requirements
- Inter-agency Involvement
- Consistency with historical drainage paths

Within the Tolleson study area, there are no continuous man-made or natural watercourses. The major watercourses that are closest to the study area are the Salt and Agua Fria Rivers, which are approximately 3 miles from the study area. Hence, a major limitation is that there is not a continuous watercourse where drainage alternatives can outlet, within the study area.

The results of the recent floodplain delineation study (Dibble & Associates, April 1999) indicates that most of the storm water generated within the study area is currently conveyed to the Agua Fria River in a mostly unimproved floodplain along the north side of the UP/SPRR embankment. However, the capacity of the this floodplain to convey flow to the Agua Fria River is limited by existing developments that now contain the existing floodplain. In addition, a proposed golf course/drainage corridor within the City of Avondale is currently under design. This golf course/drainage corridor will extend one mile east from the Agua Fria River along north side of the UP/SPRR tracks. The proposed golf course/drainage corridor has a storm water design capacity of approximately 940 cfs, which corresponds to the computed 100 year peak flow rate for existing conditions.

4.2. Development of Improvement Alternatives

Several improvement alternatives have been developed to resolve or mitigate the flooding and drainage issues within the study area, through frequent coordination with the Flood Control District of Maricopa County and the City of Tolleson. In addition, a coordination meeting was also conducted with the City of Avondale to discuss any constraints or limits along the proposed downstream drainage routes. Alternatives have been developed to consider the future development in the Tolleson area, the potential benefits to the citizens, as well as the environmental concerns.

Four major drainage corridors have been studied as part of this project:

1) along 91st Avenue from Van Buren Street to the UP/SPRR;

2) along 99th Avenue from Van Buren Street to the UP/SPRR;

3) along Van Buren Street;

4) along north side of the UP/SPRR tracks.

The two principal alternatives developed for the Tolleson area involve a major drainage corridor along the UP/SPRR tracks. Under existing conditions, storm water overtops the railroad embankment at several locations and flows south to the Salt River. The proposed UP/SPRR drainage corridor facilities are intended to prevent overtopping of the existing railroad by storm water. That is, the proposed drainage facilities along the railroad are intended to collect, convey, and/or retain the full 100-year flow event. To prevent a negative impact to the downstream floodplain, it is proposed that the storm water that currently overtops the railroad embankment be compensated for with a system of retention or detention basins in the vicinity of the UP/SPRR drainage corridor. Several possible detention or retention basin locations have been evaluated in this study:

1) at the northeast corner of the 83rd Avenue and UP/SPRR;

2) at the northeast corner of the 91st Avenue and UP/SPRR;

3) at the northeast corner of the 99th Avenue and UP/SPRR;

4) at the northeast corner of the 107th Avenue and UP/SPRR;

5) at the northeast corner of the 115th Avenue and UP/SPRR;

6) at Cowden Park

7) at a park site at the southwest corner of the 86th Avenue and Van Buren Street.

Different alternatives or combinations have been considered for these corridors. These alternatives include:

- Channel or underground conduit along 91st Avenue from Van Buren to UP/SPRR.
- Channel or underground conduit along Van Buren Street from 94th Avenue to the west or southwest along the roads until it drains into the Agua Fria River.
- Storm drain system in Van Buren Street running from 95th Avenue to 96th Avenue then turning south along a small road west of the Tolleson Plaza and draining into a proposed retention basin at the site of the City-owned Cowden Park.
- Storm drain system in Van Buren Street connecting a channel in 99th Avenue. This storm drain is proposed in Van Buren Street from 95th Avenue to 99th Avenue, with the channel starting from the intersection of 99th Avenue with Van Buren Street and along 99th Avenue to the south until it joins a channel behind the UP/SPRR tracks.
- Channel behind the UP/SPRR, from 91st Avenue all the way west along the tracks until it connects a proposed golf course in the City of Avondale, which extends one mile east from the Agua Fria River. This channel may combine detention basins at appropriate locations along the UP/SPRR track.

- Channel starting from the intersection of 91st Avenue with the UP/SPRR, proceeding north and then turning west along the Jackson Street alignment, at the intersection of 95th Avenue and Jackson Street, and running south until it drains into the Salt River.
- Greenbelt facilities, adjacent to the UP/SPRR tracks, that include the drainage channel system, optional light rail facilities, and open-space/recreational areas. The channel systen may start at 83rd Avenue and extend westward along the UP/SPRR to the proposed golf course in the City of Avondale. The channel system may include "dual use" detention basins at appropriate locations along the UP/SPRR track.
- Channel behind the UP/SPRR from 91st Avenue to a detention basin at the northeast corner of 107th Avenue and the UP/SPRR. There is another detention basin proposed for this alternative which is located at the northeast corner of 99th Avenue and Harrison Street.

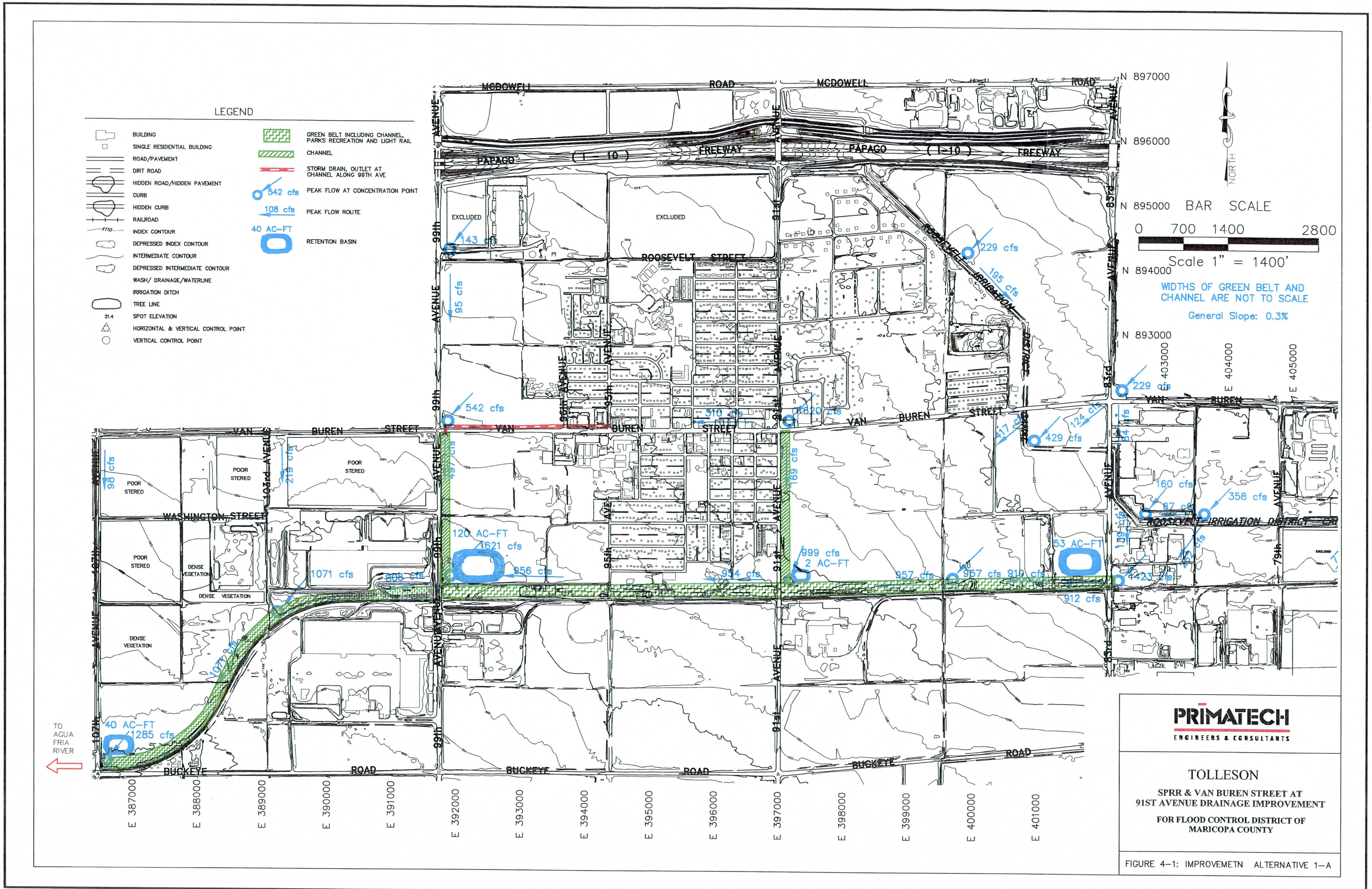
After an initial feasibility evaluation, two alternatives have been selected, together with the "do nothing" alternative, for further evaluation. The HEC-1 model developed by Dibble and Associates and provided by Flood Control District has been modified in this project to compute design peak flows and size retention/detention basins for the different alternative options, and the results are presented with the alternatives.

4.3. Alternative 1 – Full Cost/"Kinder and Gentler" Solution

The **Alternative 1** is the "environmentally friendly" or "Kinder and Gentler" (i.e. K&G) solution for the flooding issues in the study area. This alternative is intended to establish a regional drainage system that future development can link into, thereby, fostering a positive environment for future development within the City of Tolleson. A secondary benefit is that the City of Avondale also benefits from the regional drainage facilities proposed in Alternative 1.

Under existing conditions, storm water overtops the railroad embankment at several locations and flows south to the Salt River. Alternative 1 intends to prevent overtopping of the existing railroad. That is, the proposed drainage facilities along the railroad are intended to collect, convey, and/or retain the full 100-year flow event. To prevent a negative impact to the downstream floodplain, it is proposed that the storm water that currently overtops the railroad be compensated for with a system of retention or detention basins in the vicinity of the UP/SPRR drainage corridor.

Schematic diagrams for Alternative 1 are shown in Figures 4-1 to 4-3. These figures also present the hydrology results obtained with the modified HEC-1 models for these options.


LEGEND
BUILDING
SINGLE RESIDENTIAL BUILDING
ROAD/PAVEMENT
DIRT ROAD
HIDDEN ROAD/HIDDEN PAVEMENT
CURB
HIDDEN CURB
RAILROAD
INDEX CONTOUR
DEPRESSED INDEX CONTOUR
INTERMEDIATE CONTOUR
DEPRESSED INTERMEDIATE CONTOUR
WASH/ DRAINAGE/WATERLINE
IRRIGATION DITCH
TREE LINE
SPOT ELEVATION
HORIZONTAL & VERTICAL CONTROL POINT
VERTICAL CONTROL POINT
GREEN BELT INCLUDING CHANNEL, PARKS RECREATION AND LIGHT RAIL
CHANNEL
STORM DRAIN, OUTLET AT CHANNEL ALONG 99TH AVE
542 cfs
PEAK FLOW AT CONCENTRATION POINT
108 cfs
PEAK FLOW ROUTE
40 AC-FT
RETENTION BASIN
MCDOWELL ROAD
PAPAGO (I-10) FREEWAY
ROOSEVELT STREET
VAN BUREN STREET
WASHINGTON STREET
BUCKEYE ROAD
ROOSEVELT IRRIGATION DISTRICT
99th AVENUE
91st AVENUE
83rd AVENUE
107th AVENUE
EXCLUDED
POOR STEREO
DENSE VEGETATION
120 AC-FT
1621 cfs
53 AC-FT
40 AC-FT
1285 cfs
999 cfs
2 AC-FT
TO AGUA FRIA RIVER
N 897000
N 896000
N 895000
N 894000
N 893000
E 387000
E 388000
E 389000
E 390000
E 391000
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E 399000
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E 401000
E 403000
E 404000
E 405000
NORTH
BAR SCALE
0 700 1400 2800
Scale 1" = 1400'
WIDTHS OF GREEN BELT AND CHANNEL ARE NOT TO SCALE
General Slope: 0.3%
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SPRR & VAN BUREN STREET AT 91ST AVENUE DRAINAGE IMPROVEMENT
FOR FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FIGURE 4-1: IMPROVEMETN ALTERNATIVE 1-A

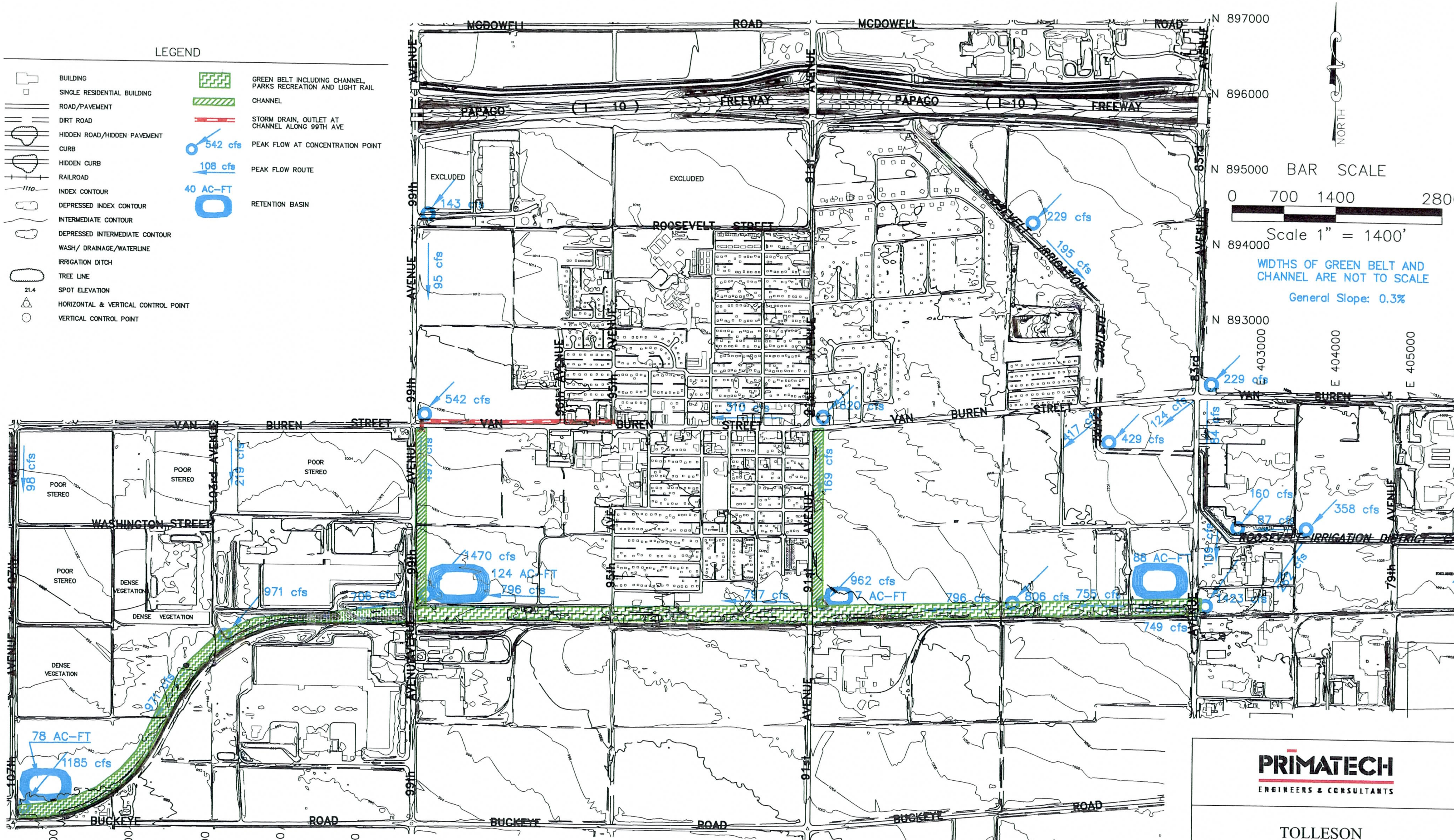

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FIGURE 4-2: IMPROVEMETN ALTERNATIVE 1-C

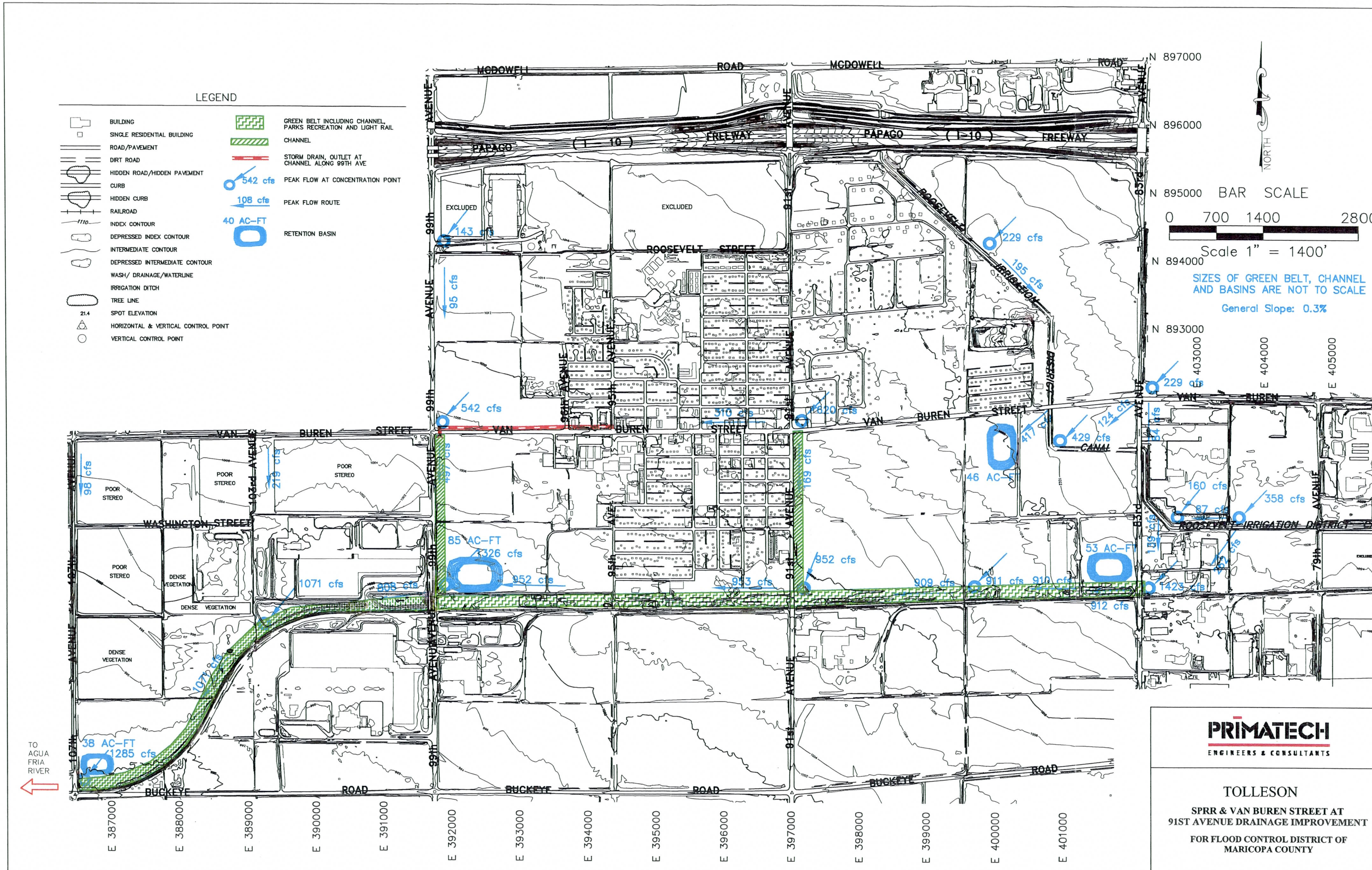
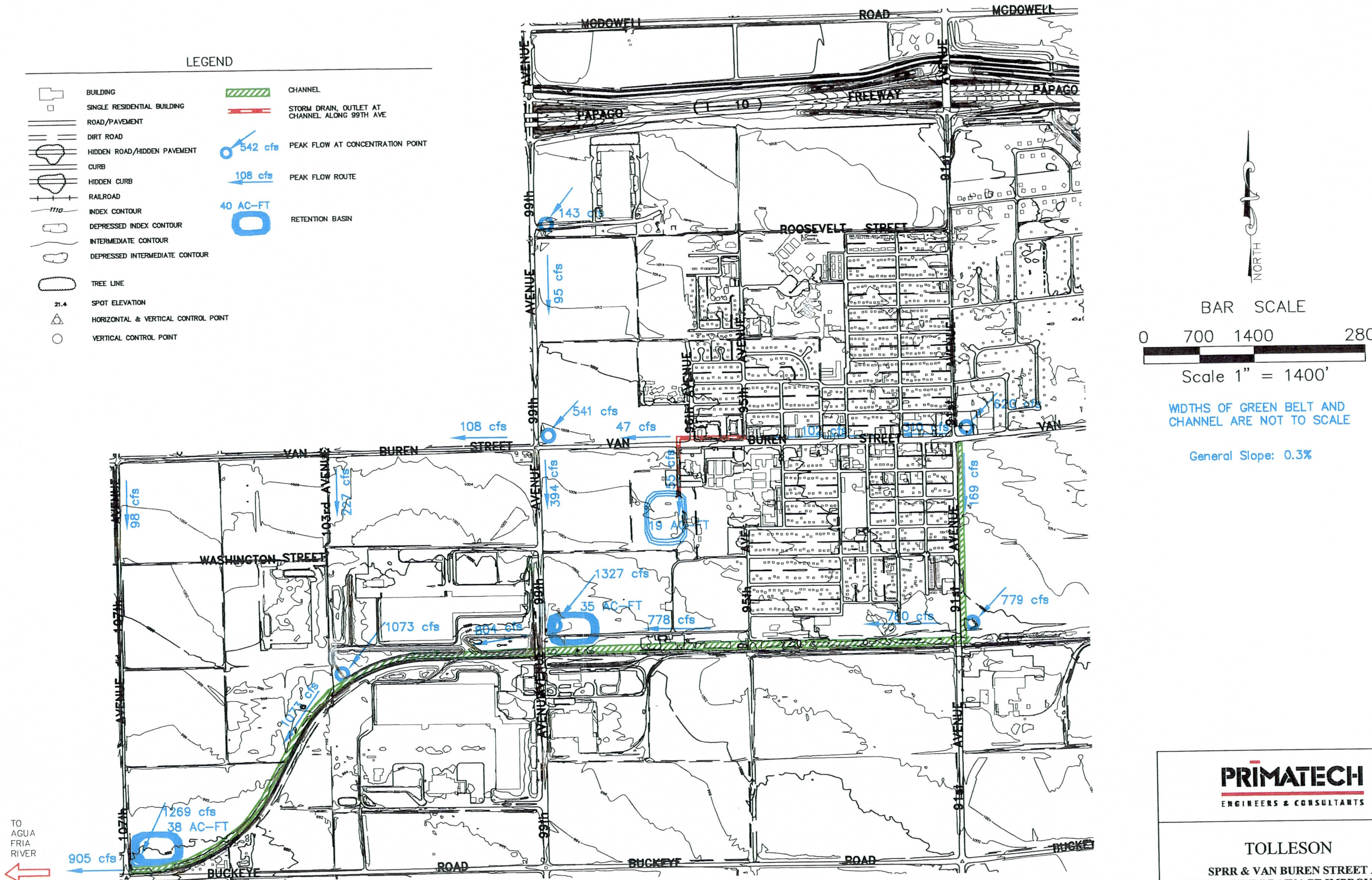


FIGURE 4-3: IMPROVEMETN ALTERNATIVE 1-D



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FOR FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE 4-5: IMPROVEMENT ALTERNATIVE 2-A

4.3.1. Components

The major components of the preferred alternative are:

- A channel (2600 LF) along east side of 91st Avenue from Van Buren Street to UP/SPRR.
- A 60-inch storm drain system (2600 LF) along Van Buren Street from 95th Avenue to 99th Avenue.
- A channel (2600 LF) along 99th Avenue from Van Buren Street to the UP/SPRR.
- A greenbelt system including drainage improvements, optional recreational facilities, and optional light rail facilities, along the north side of the UP/SPRR from 83rd Avenue to a proposed golf course facility in the City of Avondale. The proposed golf course facility is currently under design by a private developer and will extend one mile east from Agua Fria River. The proposed golf course facilities have a storm water design capacity of 940 cfs, which corresponds to the existing 100-year event per the recent floodplain delineation study (Dibble & Associates, April 1999). The total length of the channel is approximately 25,100 feet.
- Five (5) detention basins along UP/SPRR.

Optional retention facilities at the proposed park site located at the southwest corner of 86th Avenue and Van Buren Street.

This alternative is proposed with the following options: grass lined and hard lined channel options, larger detention basin option, and a retention basin option at a proposed park site located at the southwest corner of 86th Avenue and Van Buren Street. In addition, inter-government agreements with the Cities of Goodyear, Avondale, Phoenix, Tempe and Mesa will need to be established to fully implement the passenger or light rail concept.

4.3.2. Effectiveness

- This alternative will solve the flooding issues at the streets connecting 91st Avenue south of Van Buren Street, and at the intersections of 95th and 96th Avenues with Van Buren Street.
- This alternative will eliminate a portion of the floodplain along the UP/SPRR defined in the recent floodplain delineation study for the Tolleson area (Dibble & Associates, April 1999). This portion of the floodplain extends from 83rd Avenue to the proposed golf course in the City of Avondale. The proposed golf course extends one mile from Agua Fria River. Alternative 1 removes a total of approximately 260 acres from current floodplains, within the City of Tolleson.

  The majority of the storm water collected by the storm drain and channel system will be conveyed to the Agua Fria River along the original drainage routes.
- The channel along 99th Avenue is proposed to have the capacity to convey all of the peak flow collected at the intersection with Van Buren Street, so as to protect future development along 99th Avenue.

- This alternative provides the option for future development to link to a regional drainage system within the City of Tolleson and the City of Avondale.
- The proposed retention and detention basins provide optional location sites for additional recreational facilities.

4.3.3. Options and Construction Cost

Following options are evaluated with this alternative: grass lined and hard lined channel options, larger detention basin option and a retention basin option at a proposed park site at the southwest corner of 86th Avenue and Van Buren Street.

Alternative 1 includes several variations with optional components. In general, these optional components include: grass lined or hard lined channel systems at various locations, larger or smaller detention facilities, a retention basin facility at a proposed park site located at the southwest corner of 86th Avenue and Van Buren Street, and a joint-use retention basin facility within the City-owned Cowden Park. The variations of Alternative 1 are numbered as Alternatives 1-A, 1-B, 1-C and 1-D.

Grass Lining / Alternative 1-A

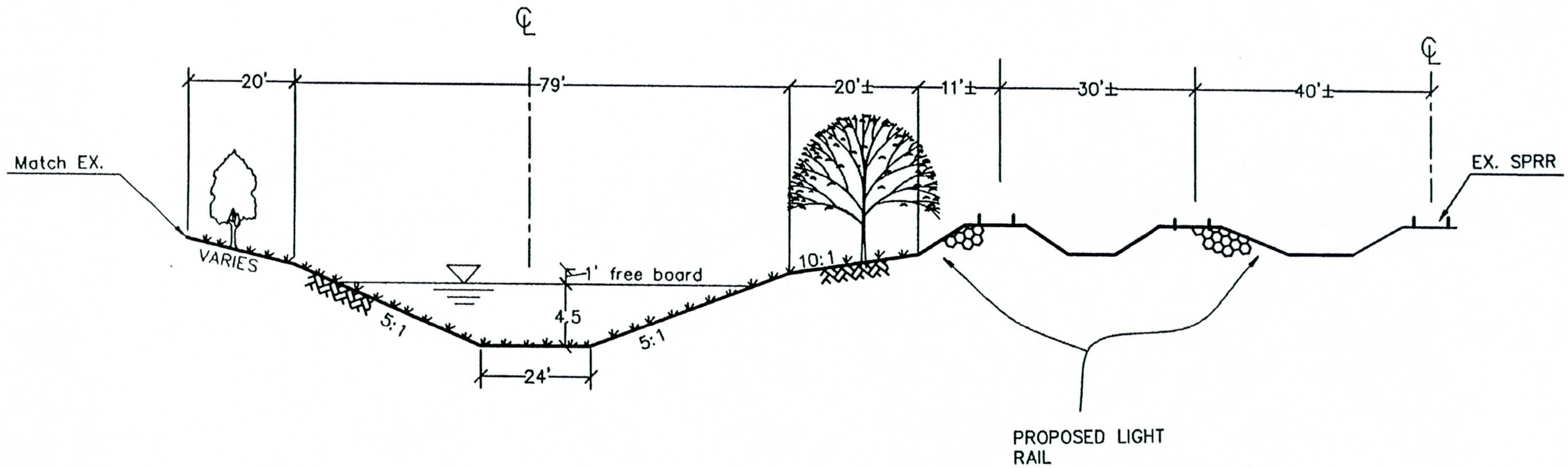
Alternative 1-A represents the basis for all of the variations of Alternative 1. That is, Alternatives 1-B through 1-D are variations of Alternative 1-A. This option includes grass lined channels for all of the major drainage corridors and five (5) park-like detention basins along the UP/SPRR embankment. Alternative 1-A is shown schematically in Figure 4-1.

Alternative 1-A has three major drainage corridors. The following is a brief description of the proposed channel systems within these corridors:

- Along the 91st Avenue drainage corridor, the typical configuration for the proposed channel has a depth of 3 feet, a bottom width of 16 feet, and a top width of 46 feet. For the design capacity of 170 cfs, the high water depth is 2.1 feet and the velocity in the channel is 3.1 ft/sec.
- Along the 99th Avenue drainage corridor, the typical configuration for the proposed channel has a depth of 4 feet, a bottom width of 26 feet, and a top width of 46 feet. For the design capacity 500 cfs, the high water depth is 3 feet and the velocity in the channel is 4 ft/sec.
- Along the UP/SPRR drainage corridor, the proposed facilities include a grass lined channel system and right-of-way for a future passenger rail system. A conceptual typical cross-section for this option is shown in Figure 4-4. The typical width of the greenbelt is approximately 150 feet from the north right-of–way of the UP/SPRR right-of -way. Along the UP/SPRR drainage corridor, the typical configuration for the proposed channel has a depth of 5.5 feet, a bottom width of 24 feet, and a top width of 79 feet. For the design flow of approximately 950 cfs, the high water depth is 4.5 feet and the velocity in the channel is 4.6 ft/sec.

CONCEPTUAL TYPICAL CROSS-SECTION OF GREEN BELT ALONG THE SPRR

NOT TO SCALE



Q100=950 cfs

SLOPE ALONG THE CHANNEL 0.2%

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FOR FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE 4-4: GREEN BELT CROSS SECTION

The grass lined detention basin will incorporate recreational facilities. Following are the specific volume and locations required to reduce peak flow in the channel:

- 53 acre-ft at the northeast corner of 83rd Avenue and the UP/SPRR
- 2 acre-ft at the northeast corner of 91st Avenue and the UP/SPRR
- 120 acre-ft at the northeast corner of 99th Avenue and the UP/SPRR
- 40 acre-ft at the northeast corner of 107th Avenue and the UP/SPRR
- 39 acre-ft at the northeast corner of 115th Avenue and the UP/SPRR

An initial cost estimate for each component of this alternative is listed in the Appendix C-1. The total estimated cost for this alternative is $10,968,000.

Hard Lining / Alternative 1-B

This option proposes concrete lining on channels along 91st Avenue and 99th Avenue, and soil cement lining on the channel along the UP/SPRR. The goal of this option is to reduce land acquisition costs via a more efficient channel system. The same grass lined detention basins proposed in Alternative 1-A are required with this option. Alternatives 1-A and 1-B have identical schematic diagrams; therefore, Figure 4-1 is the schematic diagrams for both Alternatives 1-A and 1-B.

Alternative 1-B has three major drainage corridors. Following is a brief description of the proposed channel systems within these corridors:

- Along the 91st Avenue drainage corridor, the typical configuration for the proposed concrete lined channel has a depth of 3.5 feet, a bottom width of 12 feet, a side slope of 1:1, and a top width of 19 feet. For the design capacity of 170 cfs, the high water depth is 2.5 feet and the velocity in the channel is 5.2 ft/sec.
- Along the 99th Avenue drainage corridor, the typical configuration for the proposed concrete lined channel has a depth of 5.3 feet, a bottom width of 12 feet, and a top width of 23 feet. For the design capacity 500 cfs, the high water depth is 4.3 feet and the velocity in the channel is 7 ft/sec.
- Along the UP/SPRR drainage corridor, the proposed facilities include a soil cement lined channel system and right-of-way for a future passenger rail system. Along the UP/SPRR drainage corridor, the typical configuration for the proposed channel has a depth of 5 feet, a bottom width of 30 feet, a side slope of 1:1, and a top width of 40 feet. For the design flow of approximately 950 cfs, the high water depth is 4 feet and the velocity in the channel is 7 ft/sec.

An initial estimated cost for each component of this alternative is listed in the Appendix C-1. The total estimated cost for this alternative is $11,377,000, which is $409,000 higher than that for a grass lining option.

Larger Detention Basins / Alternative 1-C

This option is based on the grass lined channel option – Alternative 1-A. The schematic diagram for Alternative 1-C is shown in Figure 4-2. The goal of this option is to reduce channel sizes by using larger detention basins. With this option, the peak flow in the channel along the UP/SPRR is reduced by about 150 cfs via using larger detention basin along the UP/SPRR drainage corridor. The following is the volume and locations of the detention basins required for this option:

- 88 acre-ft at north east corner of 83rd Avenue and UP/SPRR;
- 7 acre-ft at north east corner of 91st Avenue and UP/SPRR;
- 124 acre-ft at north east corner of 99th Avenue and UP/SPRR;
- 78 acre-ft at north east corner of 107th Avenue and UP/SPRR;
- 27 acre-ft at north east corner of 115th Avenue and UP/SPRR.

The grass lined earthen channel along the UP/SPRR will be 5.1 feet in depth. The typical cross-section of this channel has a bottom width of 24 feet, a top width of 75 feet , and sideslopes of 5:1 (H:V). For a design flow of 800 cfs, the high water depth is 4.1 feet and the velocity in the channel is 4.4 ft/sec.

An initial estimated cost for each component of this alternative is listed in the Appendix C-1. The total estimated construction cost for this alternative is $11,360,000, which is $392,000 higher than that with smaller detention basins and a larger channel.

Retention Basin at Proposed Park Site / Alternative 1-D

Based on Alternative 1-A, this option utilizes the City owned park site at the southwest corner of 86th Avenue and Van Buren Street to reduce the storm water flows to the UP/SPRR drainage corridor. Sized to intercept all of the overflow over the RID Canal at the bend 600 feet south of Van Buren Street, the retention basin is proposed to be 46 acre-feet in volume. The schematic diagram for Alternative 1-D is shown in Figure 4-3. This allows the detention basins along the UP/SPRR corridor to be reduced to:

- 53 acre-ft at north east corner of 83rd Avenue and UP/SPRR;
- 0 acre-ft at north east corner of 91st Avenue and UP/SPRR;
- 85 acre-ft at north east corner of 99th Avenue and UP/SPRR;
- 38 acre-ft at north east corner of 107th Avenue and UP/SPRR;
- 38 acre-ft at north east corner of 115th Avenue and UP/SPRR.

An initial estimated cost for each component of this alternative is listed in the Appendix C-1. The total estimated construction cost for this alternative is $10,882,000, which is $86,000 lower than that without the retention basin at the park site.

4.3.4. Estimated Maintenance

Irrigation water and regular maintenance work will be needed to maintain the grass lining and landscaping. In addition, there may be maintenance and repair work required after severe storm events. It is anticipated that the City of Tolleson will accept the maintenance responsibility for all of the landscaping and grass lining with the City's limits.

4.4. *Alternative 2 – Cost Effective Solution*

Alternative 2 offers an option to reduce flooding area at a minimum construction cost by using storm drains, basins and channels at critical locations. Under existing conditions, storm water overtops the railroad embankment at several locations and flows south to the Salt River. Similar to Alternative 1, Alternative 2 also intends to prevent overtopping of the existing railroad. That is, the proposed drainage facilities along the railroad are intended to collect, convey, and/or retain the full 100-year flow event. To prevent a negative impact to the downstream floodplain, it is proposed that the storm water that currently overtops the railroad be compensated for with a system of retention or detention basins in the vicinity of the UP/SPRR drainage corridor.

4.4.1. Components

The major components of the alternative are:

- A channel of 2600 feet in length along the east side of 91st Avenue from Van Buren Street to the UP/SPRR.
- A 42-inch storm drain of 1,700 feet in length conveying storm water ponding at the intersections of 95th and 96th Avenue with Van Buren Street to the city-owned Cowden Park.
- A retention basin of 19 acre-feet in volume at the City owned Cowden Park.
- A channel with a total length of 19,800 feet along the UP/SPRR from 91st Avenue to the proposed golf course in the City of Avondale.
- 3 Detention basins along UP/SPRR.

4.4.2. Effectiveness

- This alternative will solve the flooding issues at the streets connecting 91st Avenue south of Van Buren Street, and at the intersections of 95th and 96th Avenues with Van Buren Street.
- This alternative will eliminate a portion of the floodplain along the UP/SPRR defined by the recent Floodplain Delineation of the Tolleson Area. This portion starts from 91st Avenue extending to the proposed golf course in the City of Avondale. This golf course extends one mile from Agua Fria River. The portion of the eliminated floodplain within the city limit of Tolleson occupies an area of approximately 170 acres.
- The majority of the storm water collected by the storm drain and channel system will be conveyed to the Agua Fria River along the original drainage routes.

4.4.3. Options and Construction Cost

This alternative is proposed with the following options: grass lined and hard lined channel options, larger detention basin option, and a retention basin option at a proposed park site located at the southwest corner of 86th Avenue and Van Buren Street. The variations of Alternative 2 are numbered as Alternatives 2-A, 2-B, 2-C and 2-D. Schematic diagrams for Alternative 2 are shown in Figures 4-5 to 4-7. These figures also present the hydrology results obtained with the modified HEC-1 models for these options.

Grass Lining / Alternative 2-A

This option proposes grass lined channels with a side slope of 5:1 (H:V), and three (3) park-like detention basins along the UP/SPRR corridor.

Alternative 2-A has two major drainage corridors. The following is a brief description of the proposed channel systems within these corridors:

- Along the 91st Avenue drainage corridor, the typical configuration for the proposed channel has a depth of 3 feet, a bottom width of 16 feet, and a top width of 46 feet. For the design capacity of 170 cfs, the high water depth is 2.1 feet and the velocity in the channel is 3.1 ft/sec.
- Along the UP/SPRR drainage corridor, the proposed facilities are similar to Alternative 1-A and include a grass lined channel system The typical width of the greenbelt is approximately 150 feet from the north right-of–way of the UP/SPRR right-of -way. Along the UP/SPRR drainage corridor, the typical configuration for the proposed channel has a depth of approximately 5.5 feet, a bottom width of 24 feet, and a top width of 79 feet. For the design flow of approximately 950 cfs, the high water depth is 4.5 feet and the velocity in the channel is 4.6 ft/sec.

Park incorporated grass lined detention basins are required with following specific volume and locations to reduce peak flow in the channel:

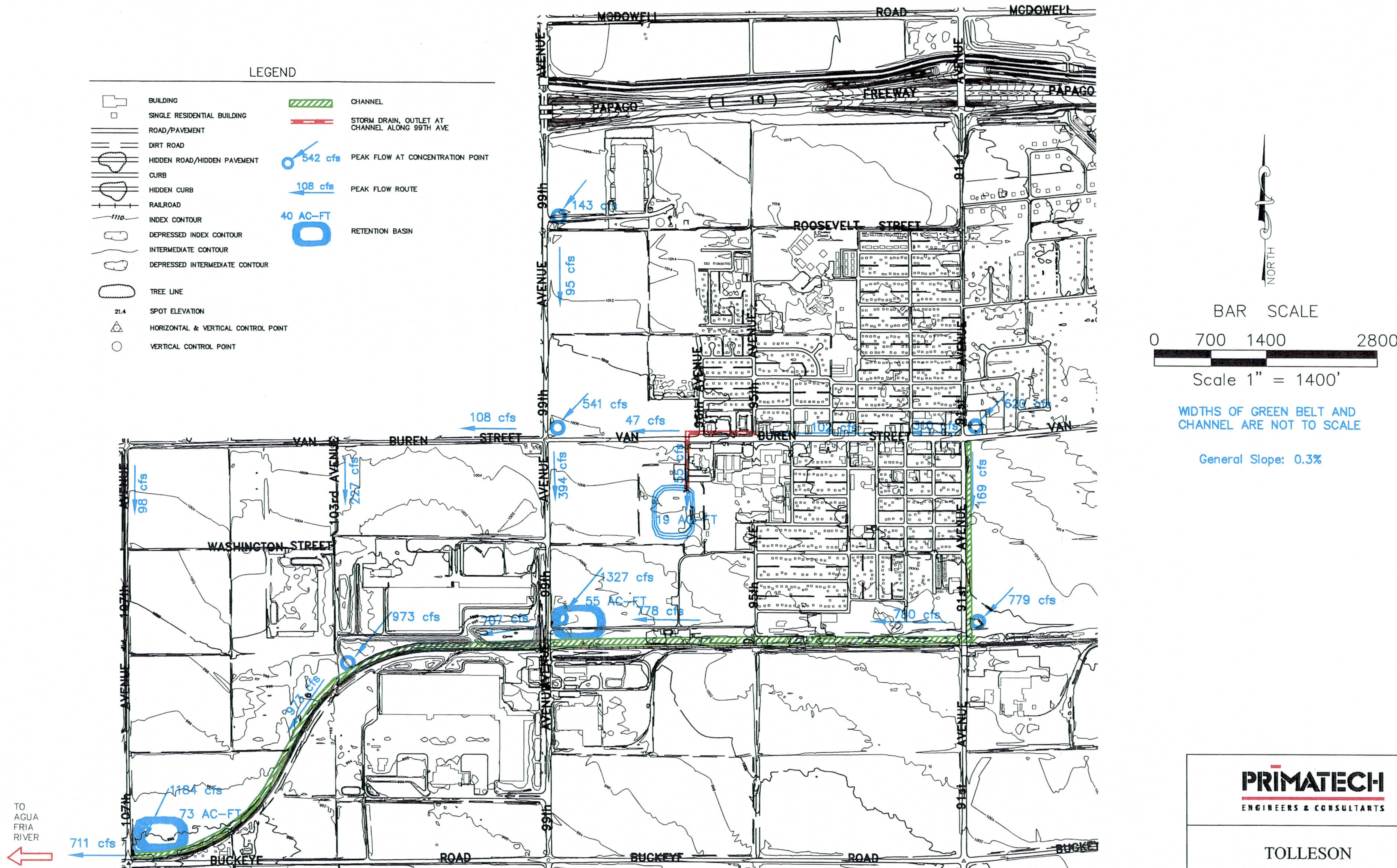
- 35 acre-ft at north east corner of 99th Avenue and UP/SPRR;
- 38 acre-ft at north east corner of 107th Avenue and UP/SPRR;
- 43 acre-ft at north east corner of 115th Avenue and UP/SPRR.

An initial estimated cost for each component of this alternative is listed in the Appendix C-2. The total estimated cost for this alternative is $6,820,000.

Hard Lining / Alternative 2-B

This option proposes concrete lining on channel along 91st Avenue, and soil cement lining on channel along the UP/SPRR. Same grass lined detention basins as proposed in Alternative 2-A are required with this option. This option is taken as the baseline option and the following options for Alternative 2 will be developed and evaluated based on this option.

Along 91st Avenue, the concrete lined channel can be 3.5 feet in depth with a bottom width of 12 feet, a top width of 19 feet and a bank slope of 1:1 (H:V). For a design flow of 170 cfs, the high water depth is 2.5 feet and the velocity in the channel is 5.2 ft/sec.



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FOR FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE 4-6: IMPROVEMENT ALTERNATIVE 2-C

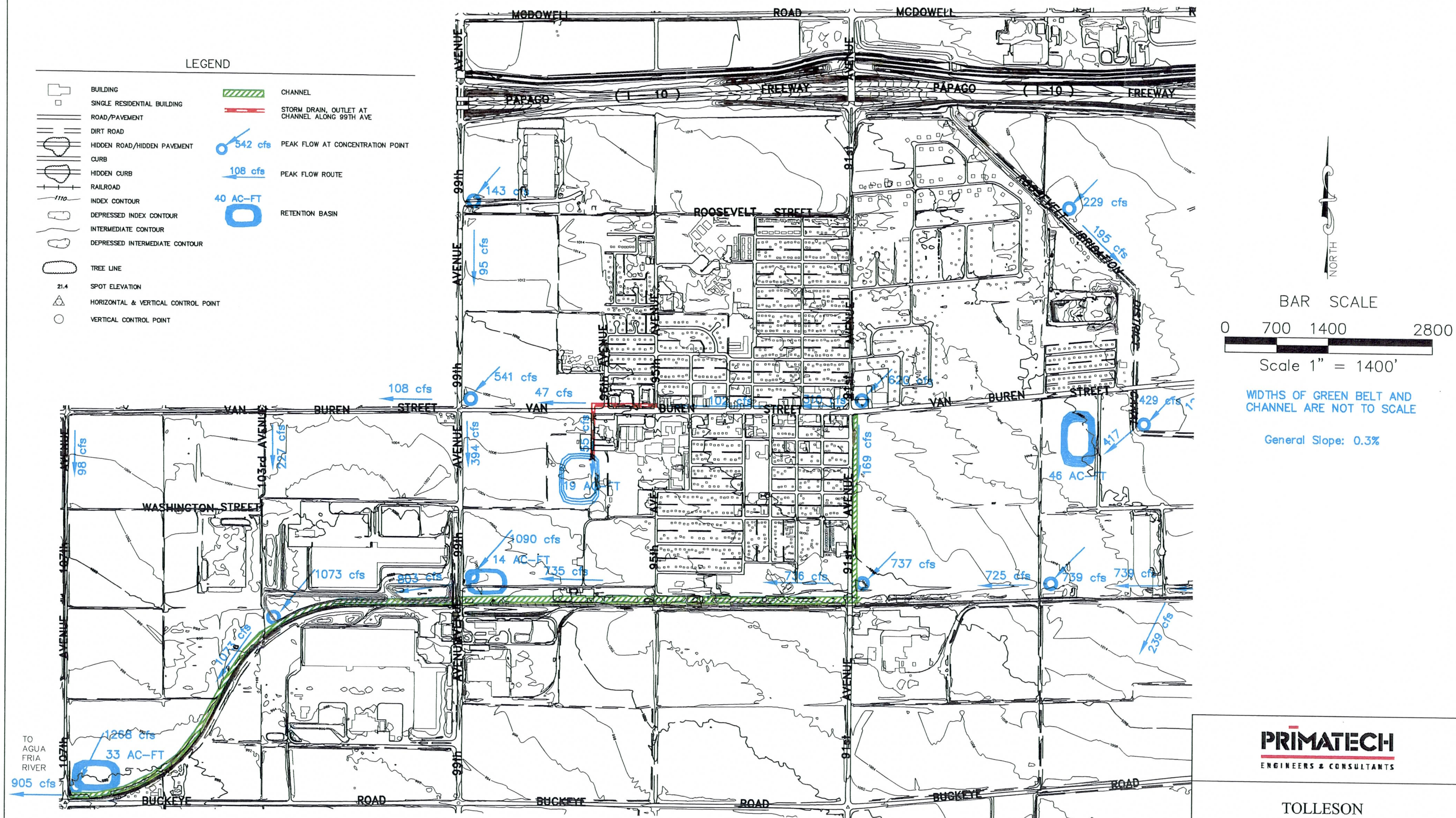

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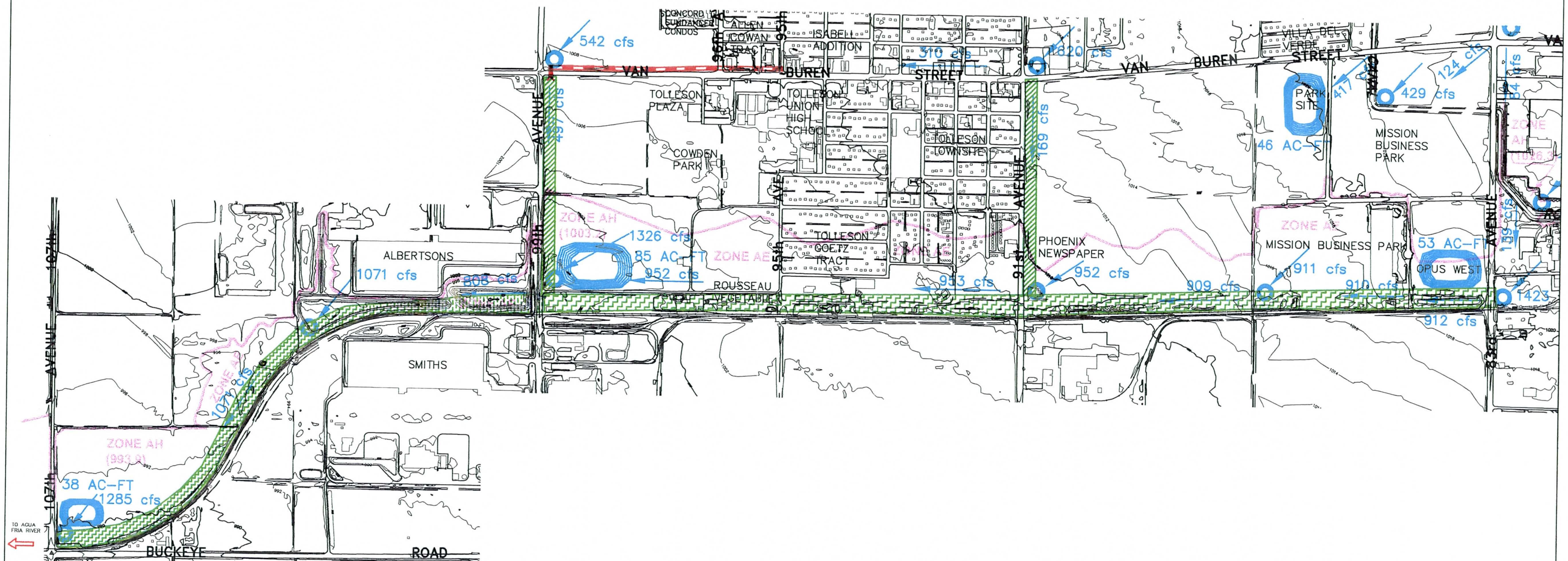
FIGURE 4-7: IMPROVEMENT ALTERNATIVE 2-D



BAR SCALE

0 600 1200 2400

Scale 1" = 1200'

NORTH

LEGEND

Symbol	Description
	BUILDING
	SINGLE RESIDENTIAL BUILDING
	ROAD/PAVEMENT
	DIRT ROAD
	HIDDEN ROAD/HIDDEN PAVEMENT
	CURB
	HIDDEN CURB
	RAILROAD
1110	INDEX CONTOUR
	DEPRESSED INDEX CONTOUR
	INTERMEDIATE CONTOUR
	DEPRESSED INTERMEDIATE CONTOUR
	TREE LINE
x21.4	SPOT ELEVATION
	HORIZONTAL & VERTICAL CONTROL POINT
	VERTICAL CONTROL POINT
	CHANNEL, PARKS, RECREATION, AND LIGHT RAIL
	CHANNEL
	STORM DRAIN PIPE
40 AC-FT	DETENTION/RETENTION BASIN
	SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD FLOODPLAIN BOUNDARY DEFINED BY FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, FLOODPLAIN DELINEATION OF THE TOLLESON AREA, FINAL REPORT, MARCH 1999
ZONE AE	BASE FLOOD ELEVATIONS DETERMINED
ZONE AH (1003.2)	FLOOD DEPTHS OF 1 TO 3 FEET (USUALLY AREAS OF PONDING); BASE FLOOD ELEVATIONS DETERMINED
429 cfs	100-YEAR, 24-HOUR PEAK FLOW AT THE CONCERNTRATION POINT
240 cfs	PEAK FLOW ROUTE

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FOR FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY

FIGURE 5-1: PREFERRED ALTERNATIVE - 1-D

An initial estimated cost for each component of this alternative is listed in the Appendix C-2. The total estimated cost for this alternative is $6,940,000, which is $120,000 higher than that for a grass lining option.

Larger Detention Basins / Alternative 2-C

This option is based on the hard lined channel option – the Alternative 2-B. With this option, the peak flow in the channel along the UP/SPRR is reduced by about 150 cfs via using larger detention basin along the UP/SPRR. Following is the volume and locations of the detention basins required for this option:

- 55 acre-ft at north east corner of 99th Avenue and UP/SPRR;
- 73 acre-ft at north east corner of 107th Avenue and UP/SPRR;
- 52 acre-ft at north east corner of 115th Avenue and UP/SPRR.

The soil cement lined channel along the UP/SPRR will be 5 feet in depth. The typical cross-section of this channel has a bottom width of 24 feet and a top width of 34 feet with a bank slope of 1:1 (H:V). For a design flow of 800 cfs, the high water depth is 4 feet, and the velocity in the channel is 7.2 ft/sec.

An initial estimated cost for each component of this alternative is listed in the Appendix C-2. The total estimated construction cost for this alternative is $7,477,000, which is $537,000 higher than that for Alternative 2-B with smaller detention basins and a larger channel.

Retention Basin at Proposed Park Site / Alternative 2-D

Based on Alternative 2-B, this option utilize the City owned park site at the southwest corner of 86th Avenue and Van Buren Street to reduce the storm water flows to the UP/SPRR so as to reduce the retention basin along the UP/SPRR and the cost.

Sized to intercept all of the overflow over the RID Canal at the bent 600 feet south of Van Buren Street, the retention basin is proposed to be 46 acre-feet in volume. The detention basins along the UP/SPRR can be reduced to:

- 14 acre-ft at north east corner of 99th Avenue and UP/SPRR;
- 33 acre-ft at north east corner of 107th Avenue and UP/SPRR;
- 41 acre-ft at north east corner of 115th Avenue and UP/SPRR.

An initial estimated cost for each component of this alternative is listed in the Appendix C-2. The total estimated construction cost for this alternative is $6,700,000, which is $240,000 lower than that without the retention basin at the park site.

CROSS SECTION OF SOIL CEMENT LINED TOLLESON FLOOD CONTROL CHANNEL

NOT TO SCALE

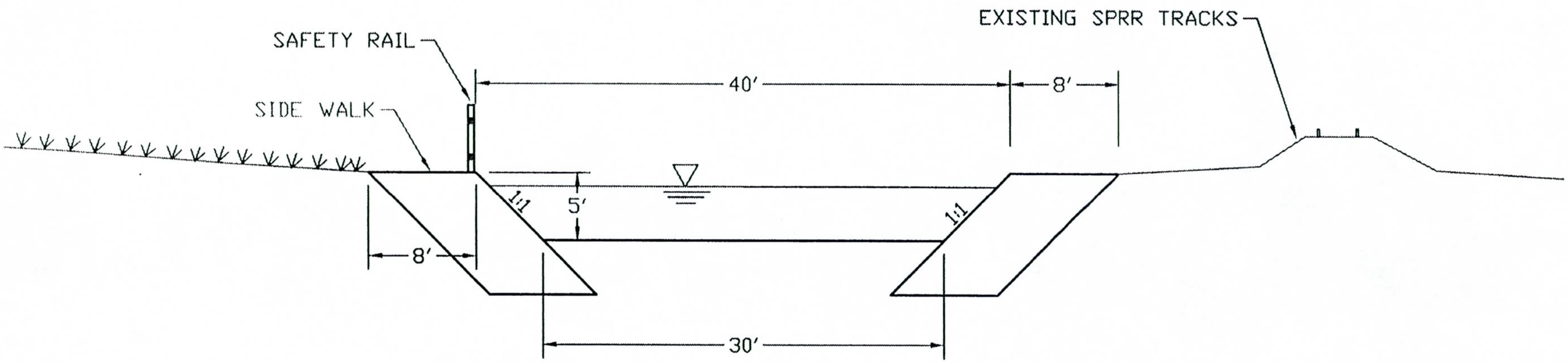

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FIGURE 4-8: CROSS SECTION OF SOIL CEMENT LINED CHANNEL

4.4.4. Estimated Maintenance

There may be maintenance and repairing work after severe storm event as the common situation of any other drainage system. City of Tolleson may accept the maintenance cost and responsibility in the City of Tolleson area.

4.5. Alternative 3 – Do Nothing

Alternative 3 is a "do nothing alternative" that involves allowing future development to implement future drainage improvements that may positively impact the specific study areas addressed in this CAR. Recent development along the UP/SPRR embankment floodplain has involved construction of retention basins and/or channel systems to remove the proposed development from the FEMA floodplain.

The possible development types and roadway improvements that may relieve some of the drainage concerns are:

- Industry development along the UP/SPRR – as completed by the warehouse development of Albertson's: New development along the UP/SPRR should be required to provide adequate retention basins and adequate pad elevations to ensure that they are out of the floodplain. These drainage facilities should be connected eventually to allow storm water to drain gradually downstream along the UP/SPRR to the Agua Fria River.
- Fishing lake and park construction – along with the development of the City park located south of Van Buren Street at 86th Avenue: A retention basin can be constructed incorporating with the fishing lake, picnic, and playground park concept, as presented in the General Plan of City of Tolleson. This retention basin should be proposed to intercept the overflow from the RID Canal at the bend located approximately 600 feet south of Van Buren Street.
- 91st Avenue Improvement – a storm drain system may be constructed at the time of the proposed 91st Avenue Improvements north of Van Buren Street.
- Golf course and range development – possible future golf course and range development can be designed to include storm water drainage and retention.
- Other new residential, commercial and industry development –adequate retention should be required for the new residential, commercial, and industrial development to retain the on-site and half-street off-site flow, thereby reducing storm water impacting existing downstream developments.

5. PREFERRED ALTERNATIVE

The preferred or recommended alternative, **Alternative 1-D**, is a variation of the "environmentally friendly" or "Kinder and Gentler" (i.e. K&G) solution for the flooding issues in the study or project area. As shown in Figure 5-1, Alternative 1-D is intended to establish a regional drainage system that future development can link into, thereby, fostering a positive environment for the citizens within the City of Tolleson and for future development. An added benefit is that the City of Avondale also benefits from the regional drainage facilities proposed in Alternative 1-D.

The major components of the preferred alternative, Alternative 1-D, are:

- A channel along east side of 91st Avenue from Van Buren Street to UP/SPRR.
- A 60-inch storm drain system along Van Buren Street from 95th Avenue to 99th Avenue.
- A channel along 99th Avenue from Van Buren Street to the UP/SPRR.
- A greenbelt system including drainage improvements, optional recreational facilities, and optional light rail facilities, along the north side of the UP/SPRR from 83rd Avenue to a proposed golf course facility in the City of Avondale. The proposed golf course facility is currently under design by a private developer and will extend one mile east from Agua Fria River. The proposed golf course facilities have a storm water design capacity of 940 cfs, which corresponds to the existing 100-year event per the recent floodplain delineation study (Dibble & Associates, April 1999).
- Five (5) detention basins along UP/SPRR.
- Retention facilities at the proposed park site located at the southwest corner of 86th Avenue and Van Buren Street.

Even though Alternative 1-D is the preferred or recommended alternative, it is important to note that the three alternatives described in this CAR are not mutually exclusive. That is, components of the three alternatives can be interchanged to build a unique regional drainage plan for the Tolleson area.

5.1. Recommended Construction Phases

This section presents a three-phased construction plan recommended in this project as shown in Figure 5-2. This plan is based on the existing and future development situation in the City of Tolleson. It is proposed only for the drainage facilities and the necessary grass liner, not for the light rail and extra landscape. The construction time of a light rail system is not determinable at this project time.

The following components are scheduled for **Phase 1** of the construction:

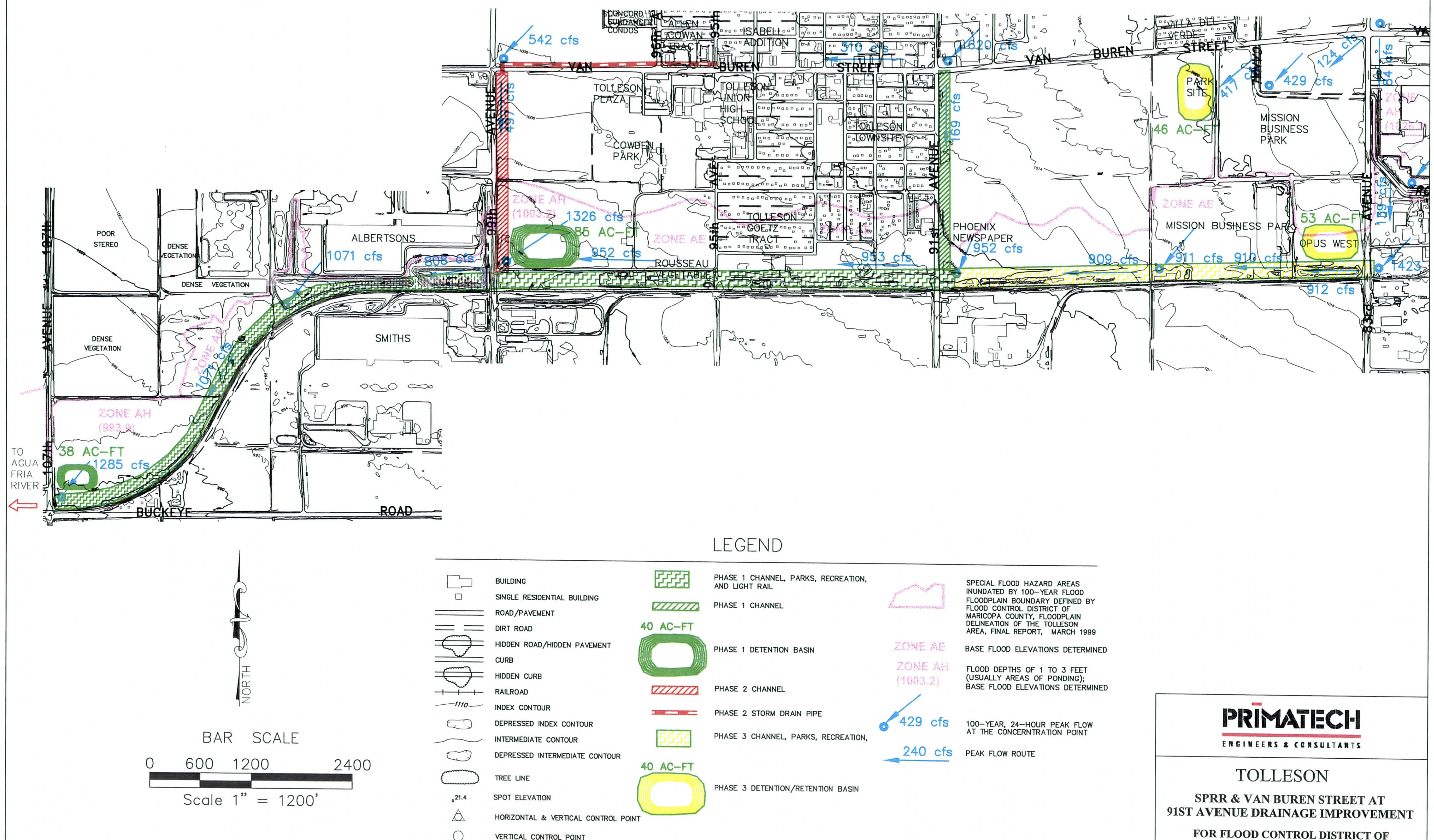
- Channel along 91st Avenue from Van Buren Street to the UP/SPRR;
- Retention facilities at the proposed park site located at the southwest corner of 86th Avenue and Van Buren Street.
- Channel along the UP/SPRR from 91st Avenue to the proposed golf course one mile east of the Agua Fria River.

The following components are scheduled for **Phase 2** of the construction:

- The storm drain in Van Buren Street from 95th Avenue to 99th Avenue.
- Channel along 99th Avenue from Van Buren Street to the UP/SPRR.

The following component is scheduled for **Phase 3** of the construction:

- Channel along the UP/SPRR from 83rd Avenue to 91st Avenue.
- The time period for each phase will depend on budget availability.



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FOR FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE 5-2: RECOMMENDED CONSTRUCTION PHASES FOR PREFERRED ALTERNATIVE

5.2. *Preliminary Design Focus Effort*

A Design Concept Report is recommend, since the design provided in this report is very preliminary. A comprehensive drainage report needs to be prepared in the DCR phase. A site survey is necessary along the drainage corridor to provide more accurate topographic and utility information for the DCR.

5.3. *Participating Agencies*

It is anticipated that, in addition to the Flood Control District of Maricopa County, the following agencies would participate in the Tolleson – UP/SPRR & Van Buren Street at 91st Avenue Drainage Improvement Project. The roles of each the agencies will be defined in an Inter-agency Agreement developed by the participating agencies.

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, AZ 85009
Business Phone (602) 506-1501

City of Tolleson
9555 West Van Buren Street
Tolleson, Arizona 85353
Business Phone: (602) 936-7111

City of Avondale
1211 South Fourth Street
Avondale, Arizona 85323
Business Phone: (602) 932-1909

Salt River Project
Water Engineering
Mail Station PAB106
Phoenix, AZ 85072
Business Phone: (602) 236-2902

Union Pacific Railroad
1416 Dodge Street
Omaha, NE 68179
Business Phone: (402) 997-3623

6. REFERENCES

Floodplain Delineation of the Tolleson Area, Hydrology Report, prepared for Flood Control District of Maricopa County, by Dibble & Associates, March 24, 1999.

Floodplain Delineation of the Tolleson Area, Final Report and Technical Data Notebook, prepared for Flood Control District of Maricopa County, by Dibble & Associates, March 1999.

Floodplain Delineation of the Tolleson Area, Field Reconnaissance Report, prepared for Flood Control District of Maricopa County, by Dibble & Associates and JE Fuller/ Hydrology & Geomorphology, Revised October, 1997.

Van Buren Street Drainage, Proposal for Flood Control District of Maricopa County CIP Project for Fiscal Year 95/96, City of Tolleson, October 7, 1994.

Southern Pacific Railroad Tracks Drainage Improvements, Proposal for Flood Control District of Maricopa County CIP Project for Fiscal Year 95/96, City of Tolleson, October 7, 1994.

U.S. Department of Housing and Urban Development, Federal Administration, Flood Insurance Study – City of Tolleson, Maricopa County, Arizona, August, 1978.

City of Tolleson, General Plan – 1996.

Initial Design Concept Report – 91st Avenue – Interstate 10 to Van Buren Avenue, City of Tolleson, prepared by Willdan Associates, Phoenix, Arizona, May, 1994.

Southwest Valley Transportation Study, Maricopa County Department of Transportation, Final Report and Appendix A, Supplementary Tables, prepared by BRW, Inc., April 1997.

City of Tolleson, 91st Avenue Conceptual Drainage Report, prepared by Willdan Associates, Phoenix, Arizona, April, 1994.

Z &H Engineering, Inc., Final Drainage Study Report for the Villa Rica Residential Subdivision, Tolleson, Arizona, January, 1995.

Department of Water Resources Hydrologic Map Series Report Number 12 – Maps Showing Groundwater Conditions in the West Salt River, East Salt River, Lake Pleasant, Carefree and Fountain Hills Sub-basins of the Phoenix Active Management Area, Maricopa, Pinal and Yavapai Counties, Arizona – 1983, State of Arizona Department of Water Resources, Phoenix, Arizona, July, 1986.

APPENDIX A

Data Collection and Photograph Log

APPENDIX A-1: Data Collection List

Appendix A-1: Data Collection List

The following agencies were contacted for information, data, maps, as-builts, plans, published reports, and manuals during the study:

- Flood Control District of Maricopa County
- Maricopa County Department of Transportation
- Maricopa County Assessors Office
- City of Tolleson
- City of Avondale
- City of Phoenix
- Arizona Department of Water Resources
- Arizona Department of Transportation
- Roosevelt Irrigation District
- Salt River Project, Water
- Salt River Project, Power
- US West
- Southwest Gas Corporation

The following documentation was acquired from the above sources for use in evaluating this site:

1. Floodplain Delineation of the Tolleson Area, Hydrology Report, prepared for Flood Control District of Maricopa County, by Dibble & Associates, April 24, 1999.
2. Floodplain Delineation of the Tolleson Area, Final Report and Technical Data Notebook, prepared for Flood Control District of Maricopa County, by Dibble & Associates, April 1999.
3. Floodplain Delineation of the Tolleson Area, Field Reconnaissance Report, prepared for the Flood Control District of Maricopa County, by Dibble & Associates and JE Fuller/Hydrology & Geomorphology, Revised October 1997.
4. Van Buren Street Drainage, Proposal for Flood Control District of Maricopa County CIP Project for Fiscal Year 95/96, City of Tolleson, October 7, 1994.
5. Southern Pacific Railroad Tracks Drainage Improvements, Proposal for Flood Control District of Maricopa County CIP Project for Fiscal Year 95/96, City of Tolleson, October 7, 1994.
6. U.S. Department of Housing and Urban Development, Federal Administration, Flood Insurance Study – City of Tolleson, Maricopa County, Arizona, August 1978.

7. Flood Control District of Maricopa County, Maryvale Area Drainage Master Study, topographic maps, Sheets 206, 207, 220, 221, 233, 234, 235, 236, 247, 248, 249, and 250, undated.

8. Maricopa County Assessor Maps, Book 101, Maps 4, 7, 8, 9, 10, 11 (4 sheets), Book 102, Maps 46 (2 sheets), 48 (4 sheets), 49, 50, 51, 52, and 53 (3 sheets).

9. Phoenix Engineering Department Storm Drain Map, G-3, (North of Tolleson Area), Undated.

10. City of Phoenix, Water & Wastewater Department, Sewer Quarter-section Maps, 9-5, 9-8, 10-5 and 10-8, dated from 1991 to 1998.

11. City of Tolleson, Water Map, revised August 8, 1994.

12. City of Tolleson, Sewer Map, revised November 1, 1994.

13. Maryvale Aerial Photographs, Numbers 526, 527, 528, 529, 553, 554, 555, 556, 565, 566, 567 and 568, dated April 21, 1994.

14. FEMA Flood Insurance Rate Maps Panel Number 0413C2105 D, Effective Date: April 15, 1988 and Panel Number 0413C2085 E, Map Revised: September 4, 1991.

15. Irrigation Facility Map, Roosevelt Irrigation District, Maricopa County, Arizona, Revised 1976, Correct to May 1984.

16. Irrigation Facility Plans, As Built, Salt River Project, Water Engineering, Phoenix, Arizona, Grand Canal, Lateral 21.0, 22.0, 23.0, Drain, Dated: varied.

17. Land Use Map – 1995, for City of Tolleson, GIS file.

18. Land Use Map – Future, for City of Tolleson, GIS file.

19. City of Tolleson, General Plan – 1996.

20. Map of Registered Wells in Township 1 N, Range 1 E, from Arizona Department of Water Resources, dated April 30, 1999.

21. Department of Water Resources Hydrologic Map Series Report Number 12 – Maps Showing Groundwater Conditions in the West Salt River, East Salt River, Lake Pleasant, Carefree and Fountain Hills Sub-basins of the Phoenix Active Management Area, Maricopa, Pinal and Yavapai Counties, Arizona – 1983, State of Arizona Department of Water Resources, Phoenix, Arizona, July, 1986.

22. Initial Design Concept Report – 91st Avenue – Interstate 10 to Van Buren Avenue, City of Tolleson, prepared by Willdan Associates, Phoenix, Arizona, May, 1994.

23. Southwest Valley Transportation Study, Maricopa County, Department of Transportation, Final Report and Appendix A, Supplementary Tables, prepared by BRW, Inc., April 1997.

24. City of Tolleson, 91st Avenue Conceptual Drainage Report, prepared by Willdan Associates, Phoenix, Arizona, April 1994.

25. U.S. Department of Housing and Urban Development, Federal Administration, Flood Insurance Study – City of Tolleson, Maricopa County, Arizona, August, 1978.

26. Z &H Engineering, Inc., Final Drainage Study Report for the Villa Rica Residential Subdivision, Tolleson, Arizona, January, 1995.

27. City of Tolleson, Zoning Map, August, 1997.

28. City of Tolleson, Zoning Ordinance of the City of Tolleson, prepared for Tolleson City Council, July 1987.

29. Salt River Project, Power, Salt River Project Overhead and Underground Electrical Facilities, Sheet AA-10-1, 2, 3, 4, 7, 8, 9, 12, 13, 14, 16, AA-09-1, 2, 3, 4, 5, 6, 8, 12, 13, 14, 15, 16, AA-04- 1, 4, 5, 6, 8, 9, 10, 11, 14, 15, 16, AA-03- 1, 2, 3, 4, 5, 6, 8, 10, 11, 12, 13, 14, 15, Date: Varied.

30. Maricopa County Department of Transportation, City of Tolleson – Van Buren Street Paving, 99th Avenue to 91st Avenue, As Built, June 30, 1978.

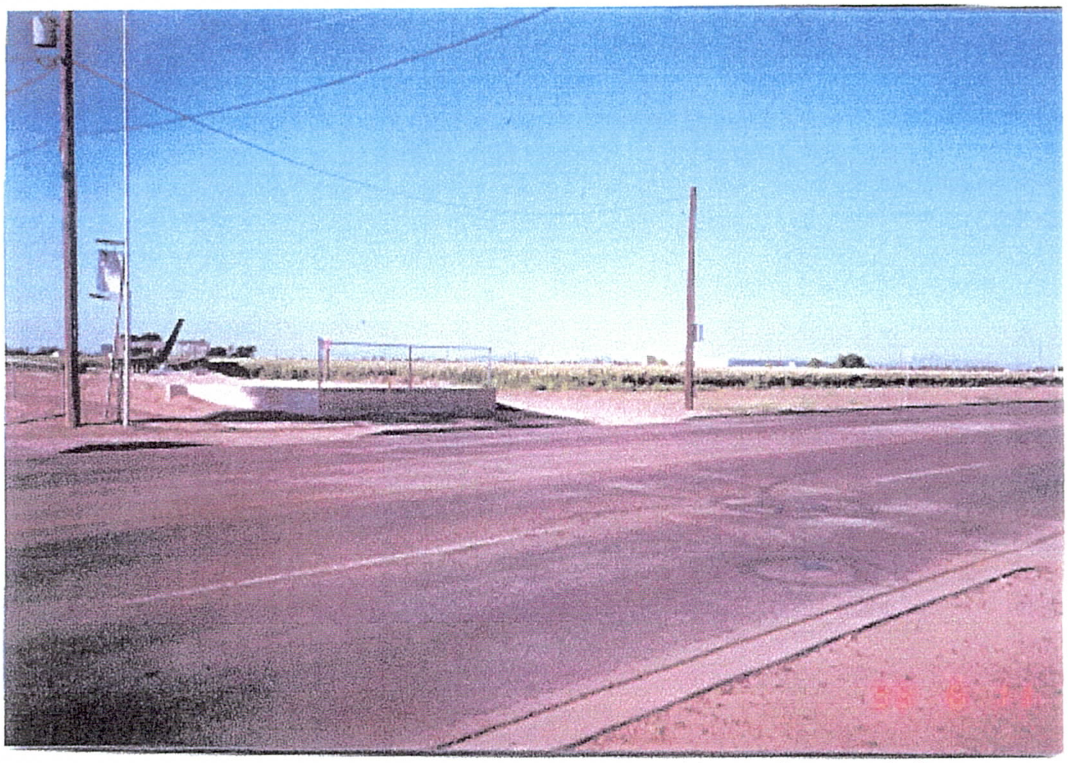
31. Arizona Department of Transportation, Ehrenberg – Phoenix Highway, 95th Avenue – 79th Avenue Section, Maricopa County, Project No. I-10-2(40), As-Built, Sheet 29, 33, 42, 43, 44, July 29, 1986.

32. US West, Buried Facility Map, T1N, R1E, Section 9, Sheet 10-5, 6, 7, 8, 11-5, 6, 7,8, Date: Varied.

33. Southwest Gas Corporation, Gas Distribution Maps, SW1/4 SEC 3 T1N – R1E, 10-6, 10-7, 11-5, 11-6, 11-7, 11-8, dated varies from 1998 to 1999.

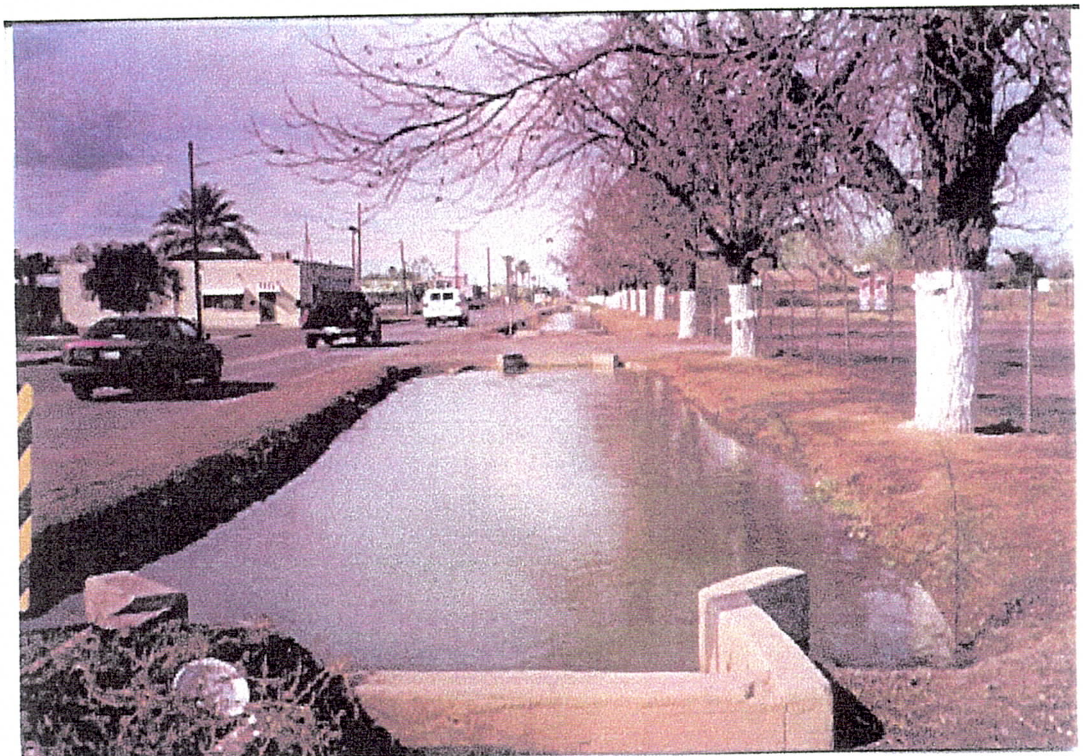
34. Flood Control District of Maricopa County, City Limit Sheets of Tolleson, Sheet 1 and Sheet 2, dated Aug. 1993 and Aug. 1990.

APPENDIX A-2: Photograph Log of Project Site



Photograph 1: Van Buren Street crossing the RID Canal with a consistent grade from east to west (looking northeast).

Photograph 2: Flow blocked along east bank of the RID Canal may split west via Van Buren Street (looking north).



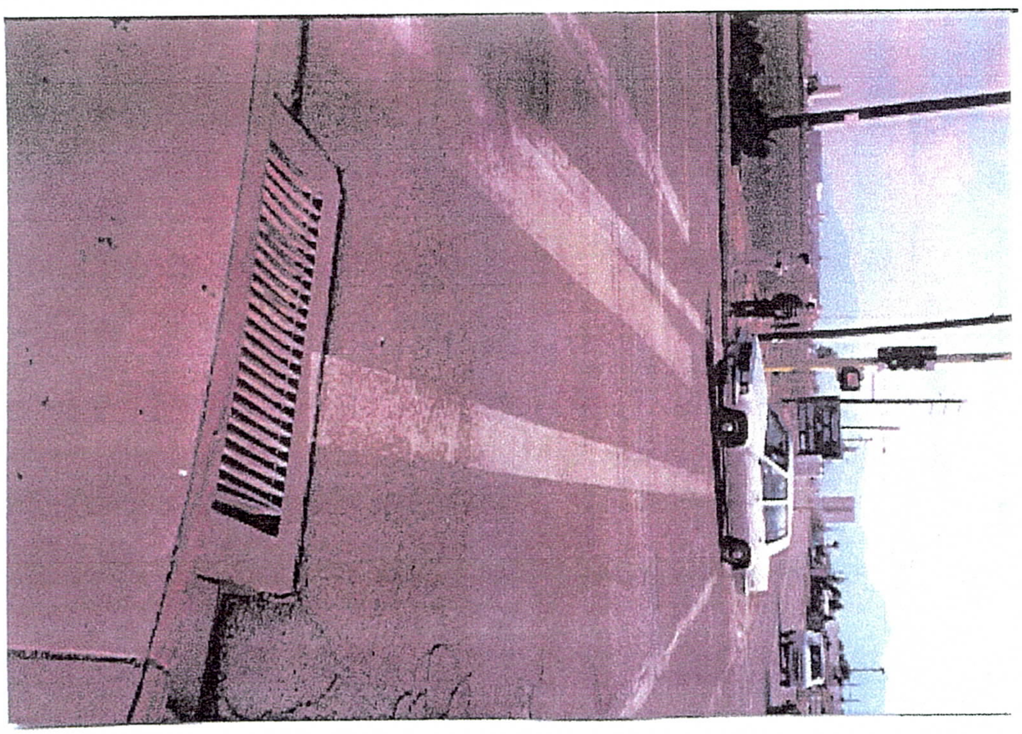
Photograph 3: SRP earthen irrigation ditch along the east side of 91st Avenue has a top width of ±12 feet and a freeboard of 0.5 to 1 foot (looking north).

Photograph 4: SRP earthen irrigation ditch along the east side of 91st Avenue with a side slope of 1:2 (H:V) (looking northwest). Historically, the SRP irrigation ditch intercepts storm water overflowing into it.

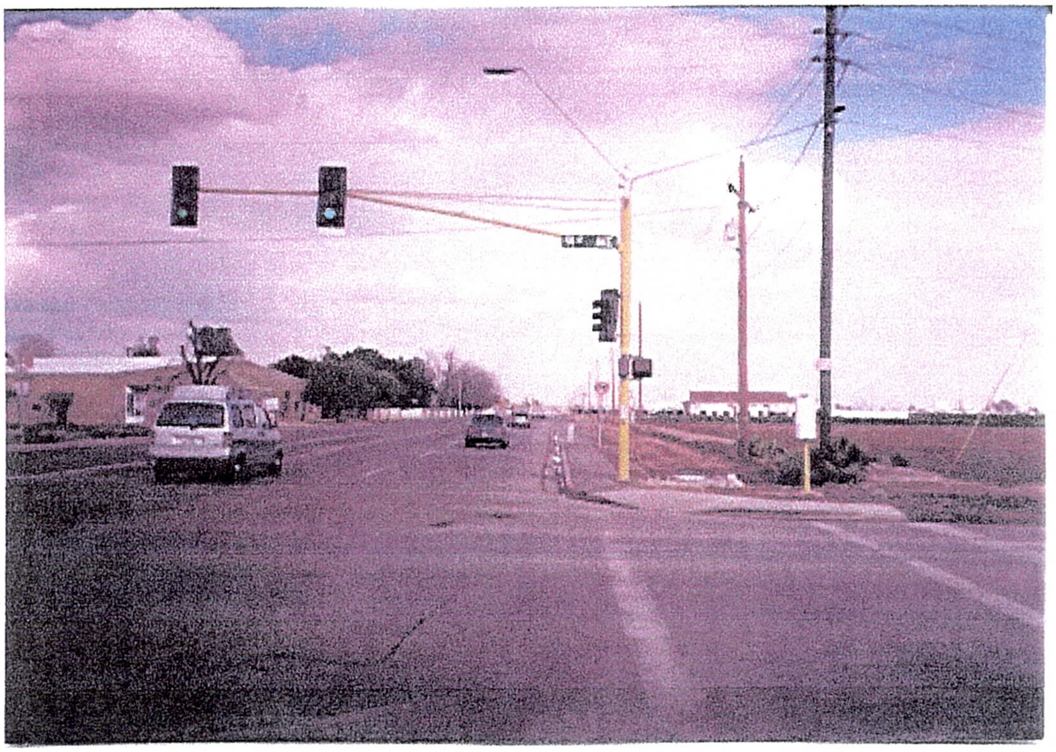
Photograph 5: South of Van Buren Street, 91st Avenue has four drive lanes with a center lane. Curb can only be found at the west side of the roadway (looking south).

Photograph 6: 91st Avenue south of SPRR (looking north). Curb can only be found at the west side of the roadway.

Photograph 7: Grate inlet at the northwest corner of the intersection of 91st Avenue with Van Buren Street.



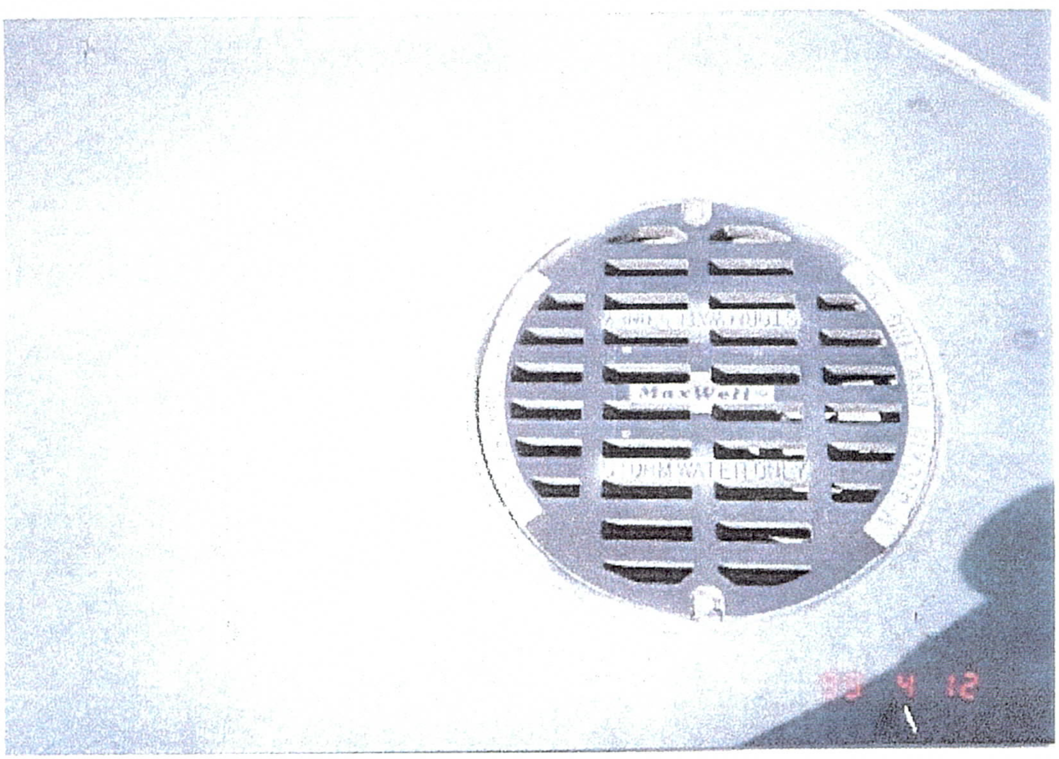
Photograph 8: Grate inlet at the northeast corner of the intersection of 91st Avenue with Van Buren Street.



Photograph 9: Van Buren Street east of 91st Avenue (looking east).

Photograph 10: Van Buren Street west of 91st Avenue (looking west).

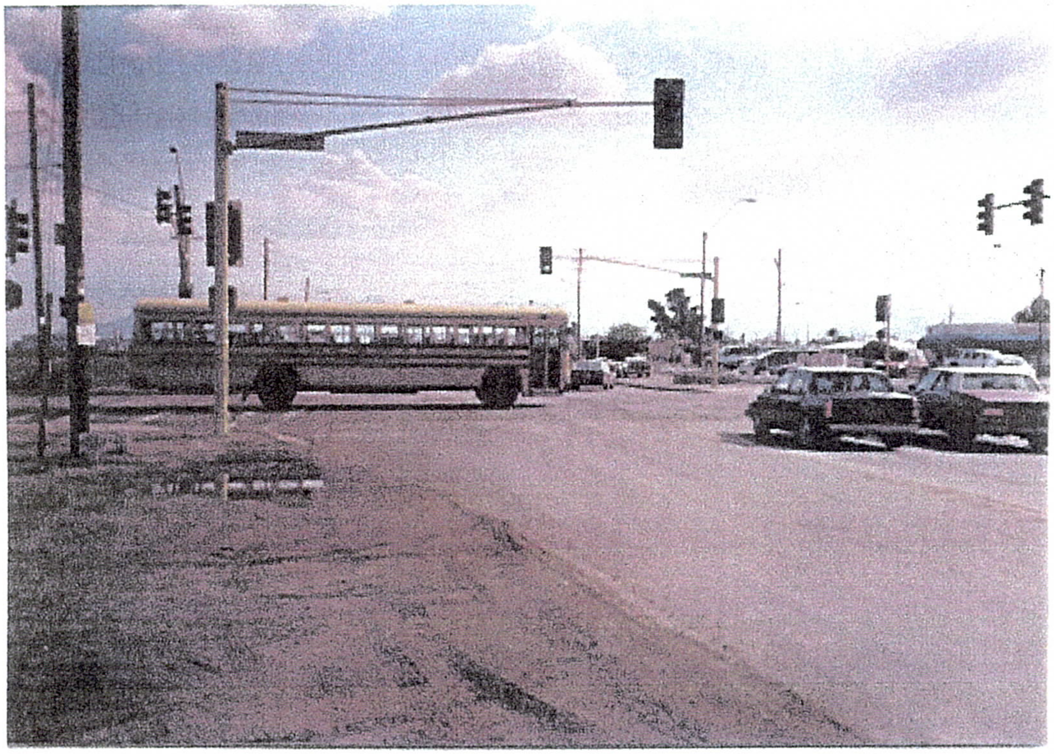
Photograph 11: Intersection of 95th Avenue and Van Buren Street (looking west).



Photograph 12: The dry well at a low point of the intersection of 95th Avenue and Van Buren Street.

Photograph 13: Floodplain along SPRR tracks west of 91st Avenue (looking west). It extends nearly one-quarter mile north from the tracks. Some small industrial developments are within the 100-year floodplain.

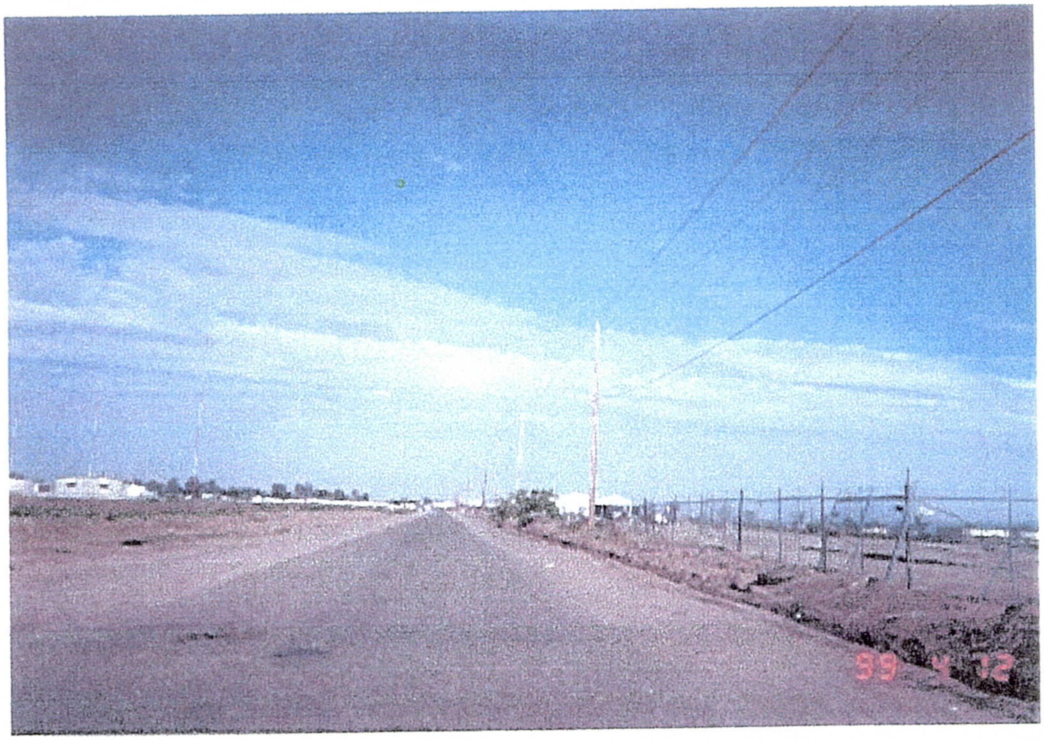
Photograph 14: Floodplain along SPRR tracks west of 91st Avenue (looking northwest). Most of the existing residential area south of Washington Street is within the 100-year floodplain.



Photograph 15: Intersection of Van Buren Street and 91st Avenue (looking south).

Photograph 16: RID Canal at 83rd Avenue (looking west).

Photograph 17: Concrete irrigation ditch along south side of Van Buren Street west of 96th Avenue (looking east).



Photograph 18: Earthen ditch along south side of Harrison Street between 99th and 95th Avenue (looking east).

Photograph 19: Local ponding at the southeast corner of 95th Avenue and Jackson Street (looking south).

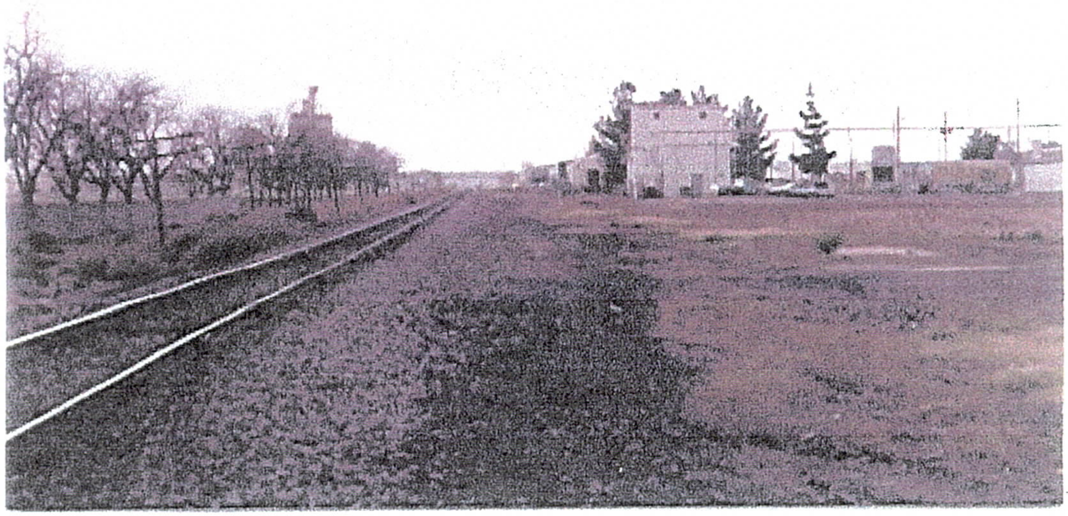
Photograph 20: Local ponding at the southwest corner of the 95th Avenue and Harrison Street (looking south).

Photograph 21: Impact of ponding at the intersection of 96th Avenue with Van Buren Street on the pavement (looking west).

Photograph 22: Water ponding in the earthen ditch along the south side of Van Buren Street (looking east). South of the earthen ditch there is a concrete irrigation ditch.

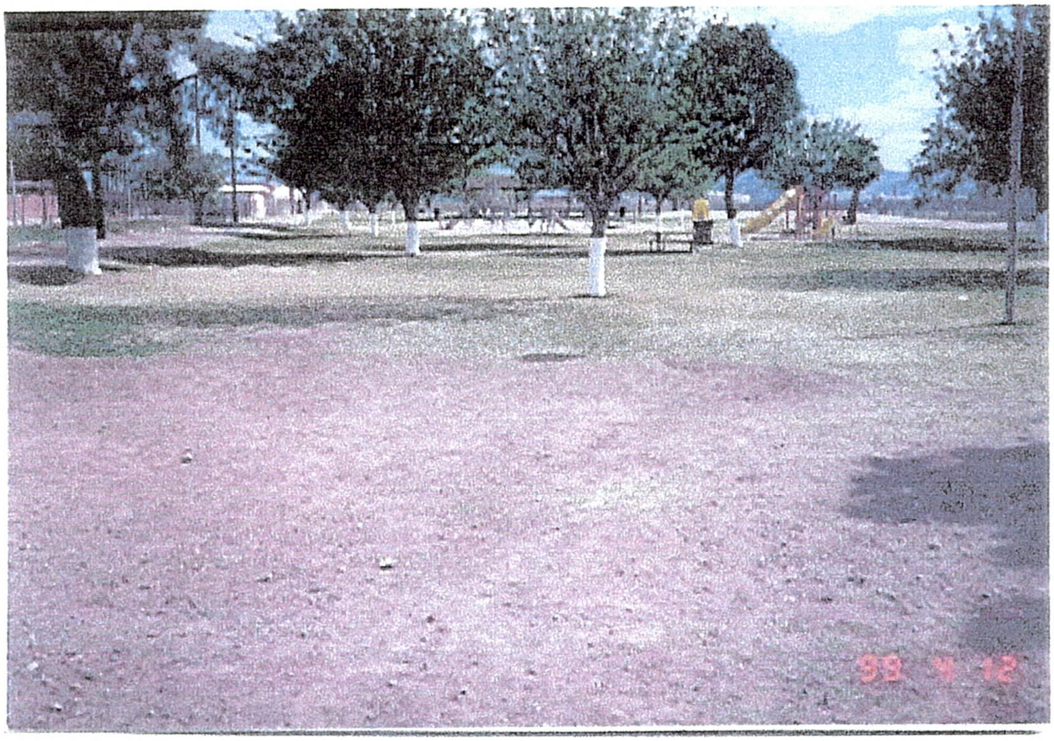
Photograph 23: Ill-maintained earthen ditch at intersection of 95th Avenue and Harrison Street (looking north).

Photograph 24: Clogged culvert crossing SPRR at 95th Avenue.



Photograph 25: Small industrial development within the proposed drainage corridor at northwest corner of 91st Avenue and SPRR (looking west).

Photograph 26: Small industrial development within the proposed drainage corridor at northeast corner of 95th Avenue and SPRR (looking east).



Photograph 27: City-owned Cowden Park located south of Van Buren Street and west of 96th Avenue, a potential retention basin site (looking south).

Photograph 28: 96th Avenue south of Van Buren Street (looking west).

Photograph 29: Irrigation Structure at the southeast corner of 91^{st} Avenue and Van Buren Street (looking west).

Photograph 30: Intersection of 91^{st} Avenue with SPRR (looking east).

Photograph 31: Intersection of 83rd Avenue with SPRR (looking west).

Photograph 32: Intersection of 99th Avenue with SPRR (looking west).

Photograph 33: RID Canal approximately 600 feet south of Van Buren Street and one-quarter mile west of 83rd Avenue.

Photograph 34: Ponding location behind the bend of the RID Canal.

APPENDIX B

Hydraulic Computations

APPENDIX B-1: Hydraulic Computations for Alternative 1

Table
Rating Table for Irregular Channel

Project Description	
Project File	d:\1prj\mfc019\hec-ras\alternat.fm2
Worksheet	Van Buren Street Capacity
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Channel Slope	0.001150 ft/ft

Input Data	Minimum	Maximum	Increment
Water Surface Elevation	10.00	10.20	0.01 ft

Rating Table

Water Surface Elevation (ft)	Wtd. Mannings Coefficient	Discharge (cfs)	Velocity (ft/s)
10.00	0.015	18.69	1.27
10.01	0.015	19.39	1.27
10.02	0.015	20.15	1.26
10.03	0.015	20.99	1.26
10.04	0.015	21.89	1.26
10.05	0.015	22.87	1.26
10.06	0.015	23.91	1.26
10.07	0.015	25.40	1.28
10.08	0.015	26.93	1.30
10.09	0.015	28.50	1.33
10.10	0.015	30.13	1.35
10.11	0.015	32.10	1.38
10.12	0.015	34.13	1.42
10.13	0.015	36.20	1.45
10.14	0.015	38.32	1.48
10.15	0.015	40.49	1.52
10.16	0.015	42.70	1.55
10.17	0.015	44.96	1.58
10.18	0.015	47.27	1.61
10.19	0.015	49.62	1.64
10.20	0.015	52.02	1.67

Cross Section
Cross Section for Irregular Channel

Project Description	
Project File	d:\1prj\mfc019\hec-ras\alternat.fm2
Worksheet	Van Buren Street Capacity
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Section Data		
Wtd. Mannings Coefficient	0.015	
Channel Slope	0.001150	ft/ft
Water Surface Elevation	10.20	ft
Discharge	52.02	cfs

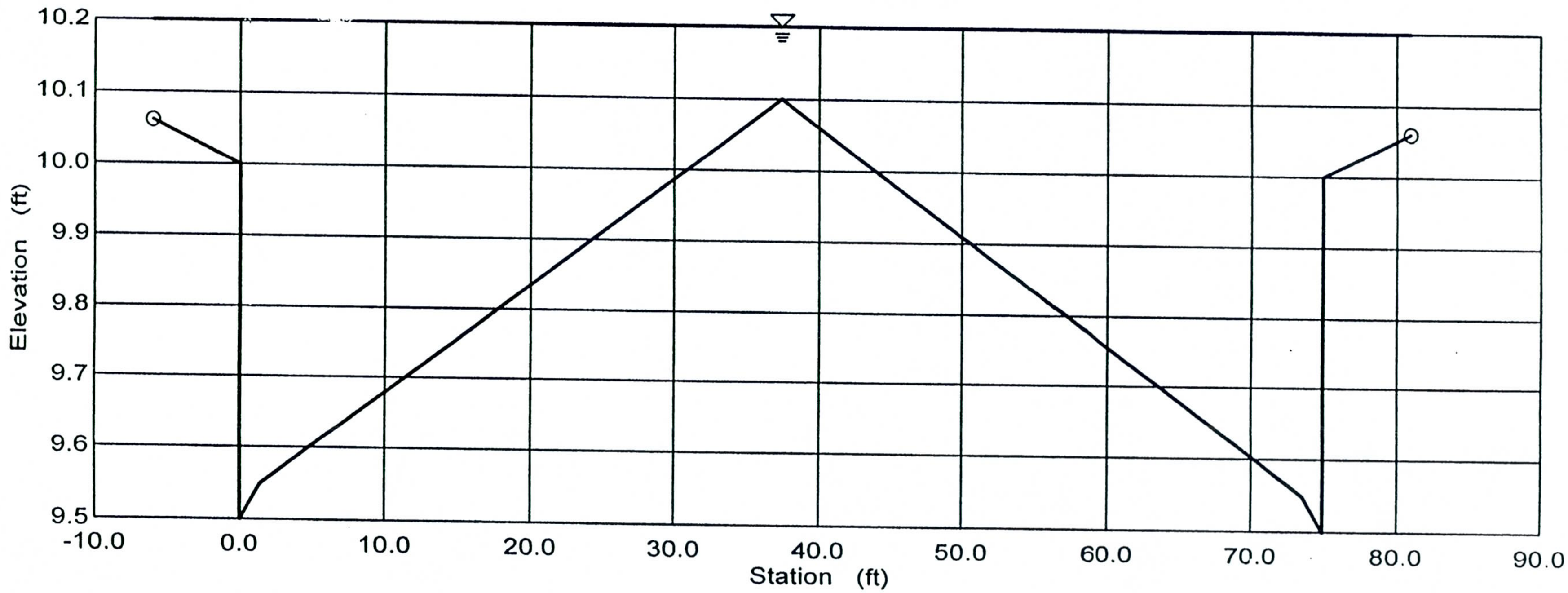


Table
Rating Table for Circular Channel

Project Description	
Project File	d:\1prj\mfc019\hec-ras\alternat.fm2
Worksheet	Storm Drain in Van Buren Street
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

Constant Data	
Mannings Coefficient	0.013
Channel Slope	0.001150 ft/ft

Input Data	Minimum	Maximum	Increment
Discharge	40.00	100.00	10.00 cfs

Rating Table

Discharge (cfs)	Depth (in)	Diameter (in)	Velocity (ft/s)
40.00	44.6	44.58	3.69
50.00	48.5	48.47	3.90
60.00	51.9	51.90	4.08
70.00	55.0	54.99	4.24
80.00	57.8	57.82	4.39
90.00	60.4	60.43	4.52
100.00	62.9	62.86	4.64

Table
Rating Table for Rectangular Channel

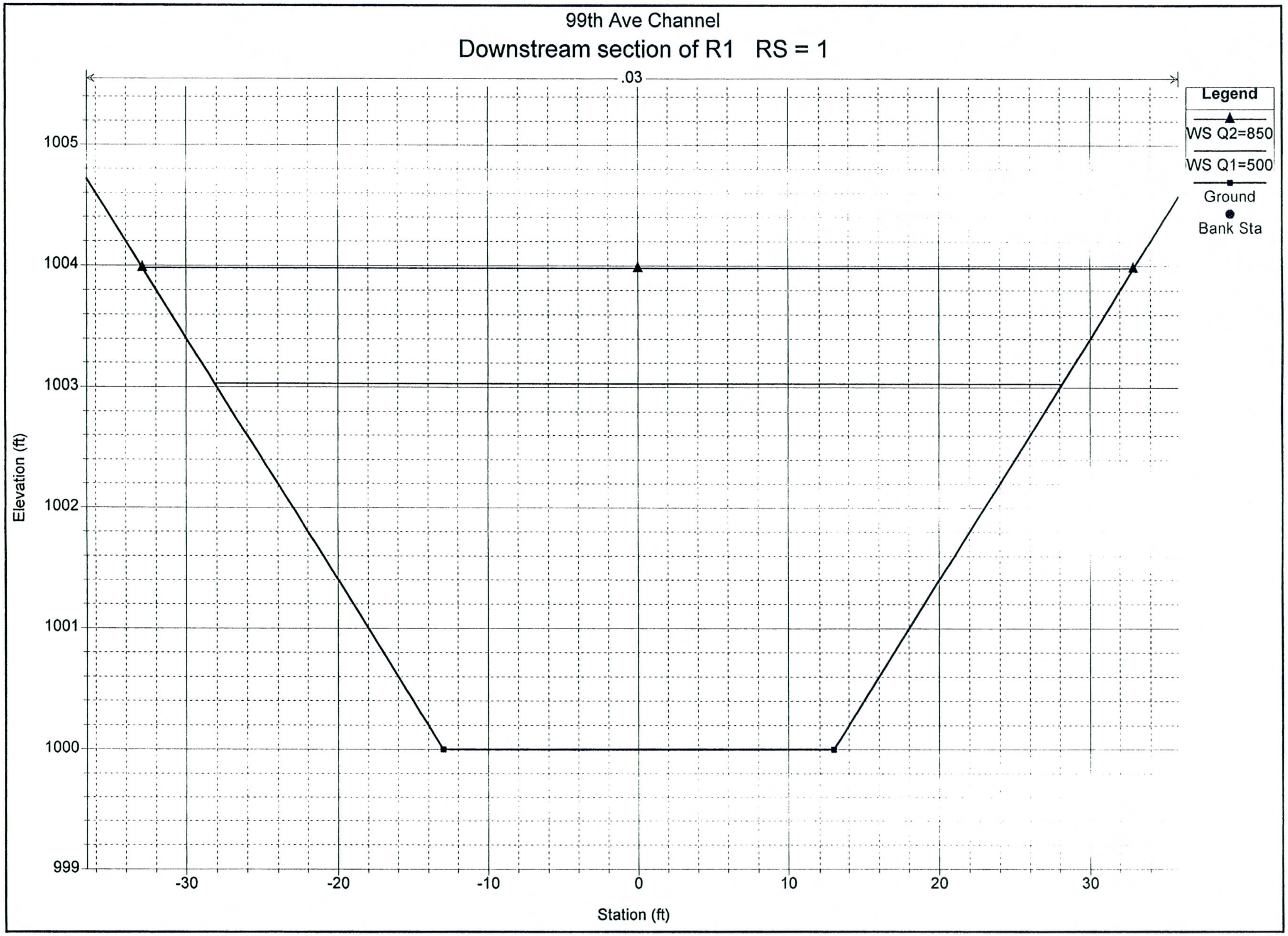
Project Description	
Project File	d:\1prj\mfc019\hec-ras\alternat.fm2
Worksheet	Culvert Crossing 91st Avenue
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.013	
Channel Slope	0.002000	ft/ft
Bottom Width	60.00	ft

Input Data	Minimum	Maximum	Increment
Discharge	1,000.00	1,800.00	100.00 cfs

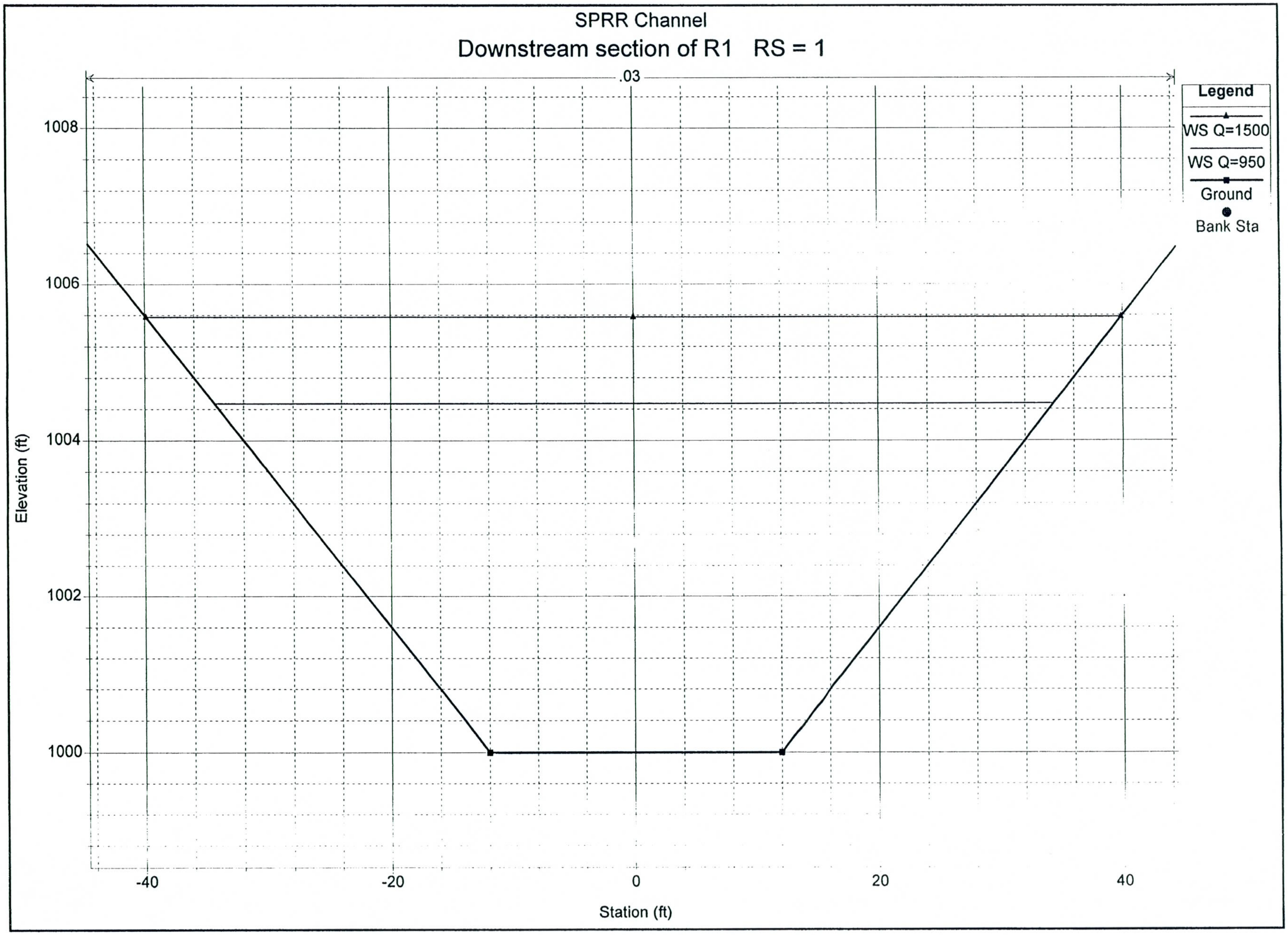
Rating Table

Discharge (cfs)	Depth (ft)	Velocity (ft/s)
1,000.00	2.09	7.98
1,100.00	2.21	8.28
1,200.00	2.34	8.56
1,300.00	2.45	8.83
1,400.00	2.57	9.08
1,500.00	2.68	9.32
1,600.00	2.79	9.55
1,700.00	2.90	9.77
1,800.00	3.00	9.99


99th Ave Channel
Downstream section of R1 RS = 1
.03
Legend
WS Q2=850
WS Q1=500
Ground
Bank Sta
Elevation (ft)
1005
1004
1003
1002
1001
1000
999
-30
-20
-10
0
10
20
30
Station (ft)

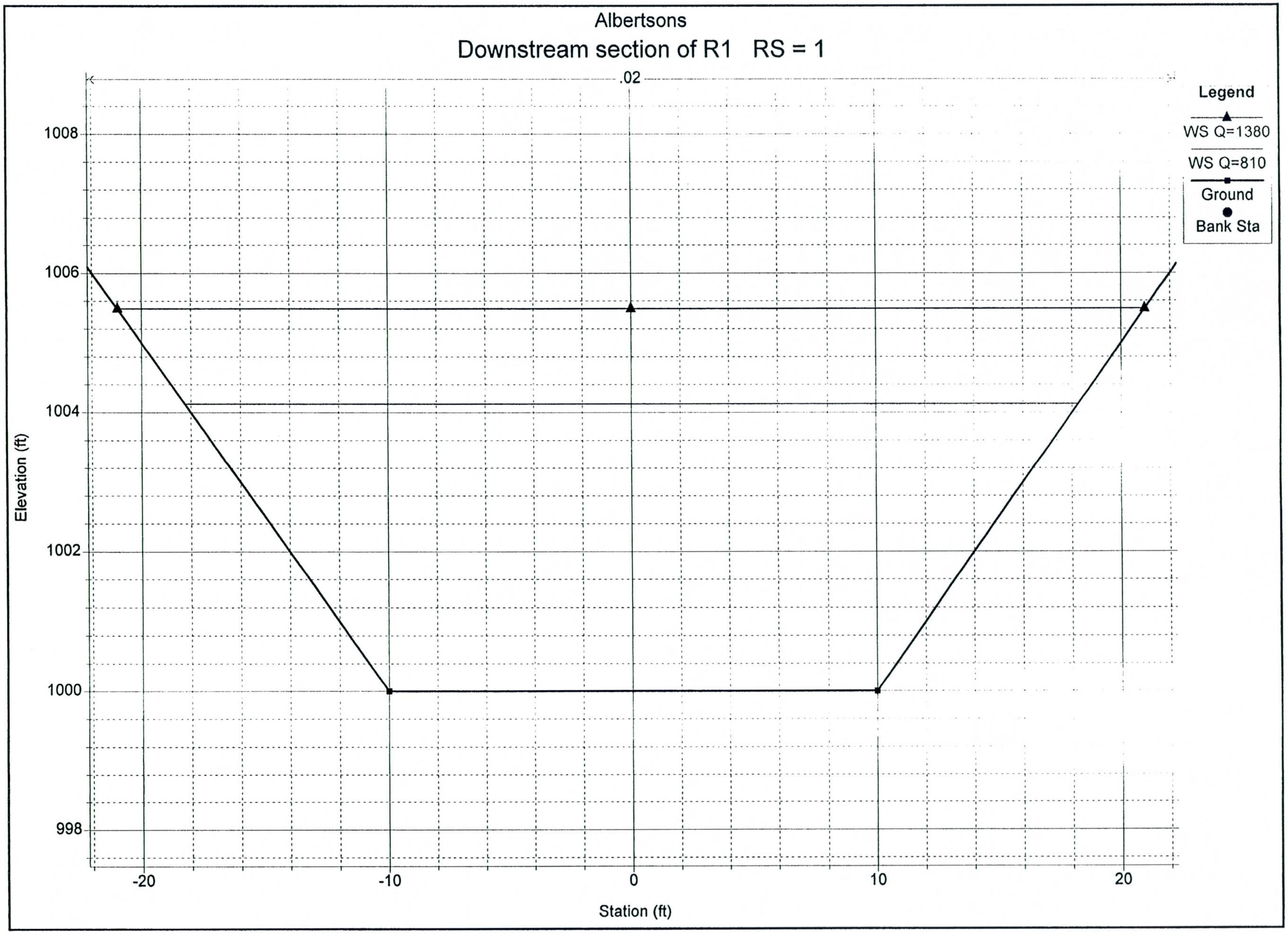
HEC-RAS Plan: A99 River: 99th Ave Channel Reach: Typical

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Typical	2	Q1=500	500.00	1009.20	1012.24		1012.48	0.002286	4.00	125.02	56.36	0.47
Typical	2	Q2=850	850.00	1009.20	1013.18		1013.52	0.002294	4.65	182.79	65.82	0.49
Typical	1	Q1=500	500.00	1000.00	1003.03	1001.97	1003.28	0.002301	4.01	124.72	56.31	0.47
Typical	1	Q2=850	850.00	1000.00	1003.98	1002.68	1004.32	0.002301	4.66	182.60	65.79	0.49


SPRR Channel
Downstream section of R1 RS = 1
.03
Legend
WS Q=1500
WS Q=950
Ground
Bank Sta
1008
1006
1004
1002
1000
Elevation (ft)
-40
-20
0
20
40
Station (ft)

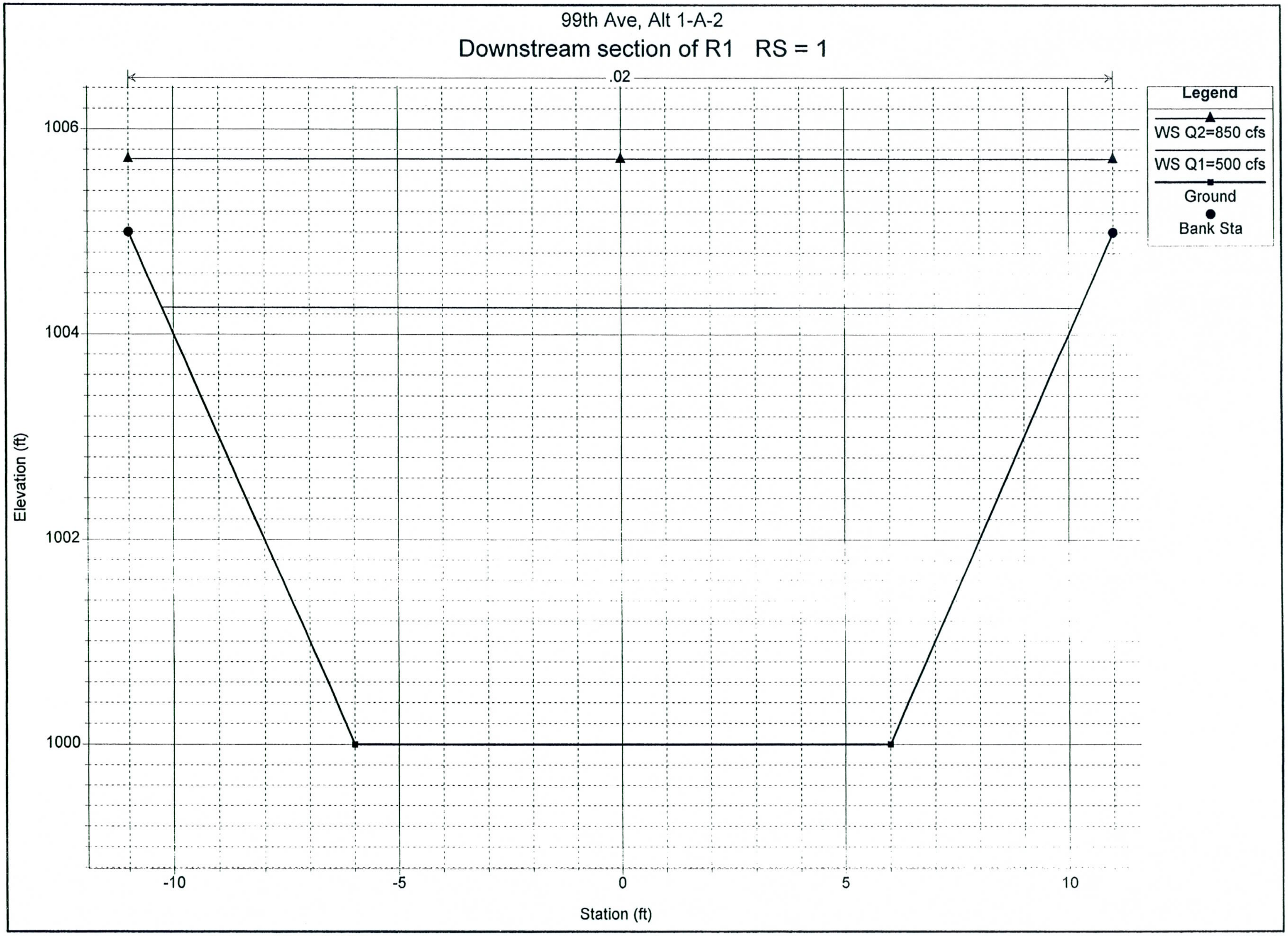
HEC-RAS Plan: Channel River: SPRR Reach: Typical

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Typical	2	950.00	1008.00	1012.47		1012.80	0.001998	4.58	207.28	68.71	0.47
Typical	2	1500.00	1008.00	1013.58		1014.00	0.001997	5.18	289.59	79.80	0.48
Typical	1	950.00	1000.00	1004.47	1002.95	1004.80	0.002003	4.59	207.10	68.69	0.47
Typical	1	1500.00	1000.00	1005.58	1003.79	1005.99	0.002001	5.18	289.42	79.78	0.48


Albertsons
Downstream section of R1 RS = 1
.02
Legend
WS Q=1380
WS Q=810
Ground
Bank Sta
1008
1006
1004
1002
1000
998
Elevation (ft)
-20
-10
0
10
20
Station (ft)

HEC-RAS Plan: Albertsons River: SPRR Channel Reach: Albertsons

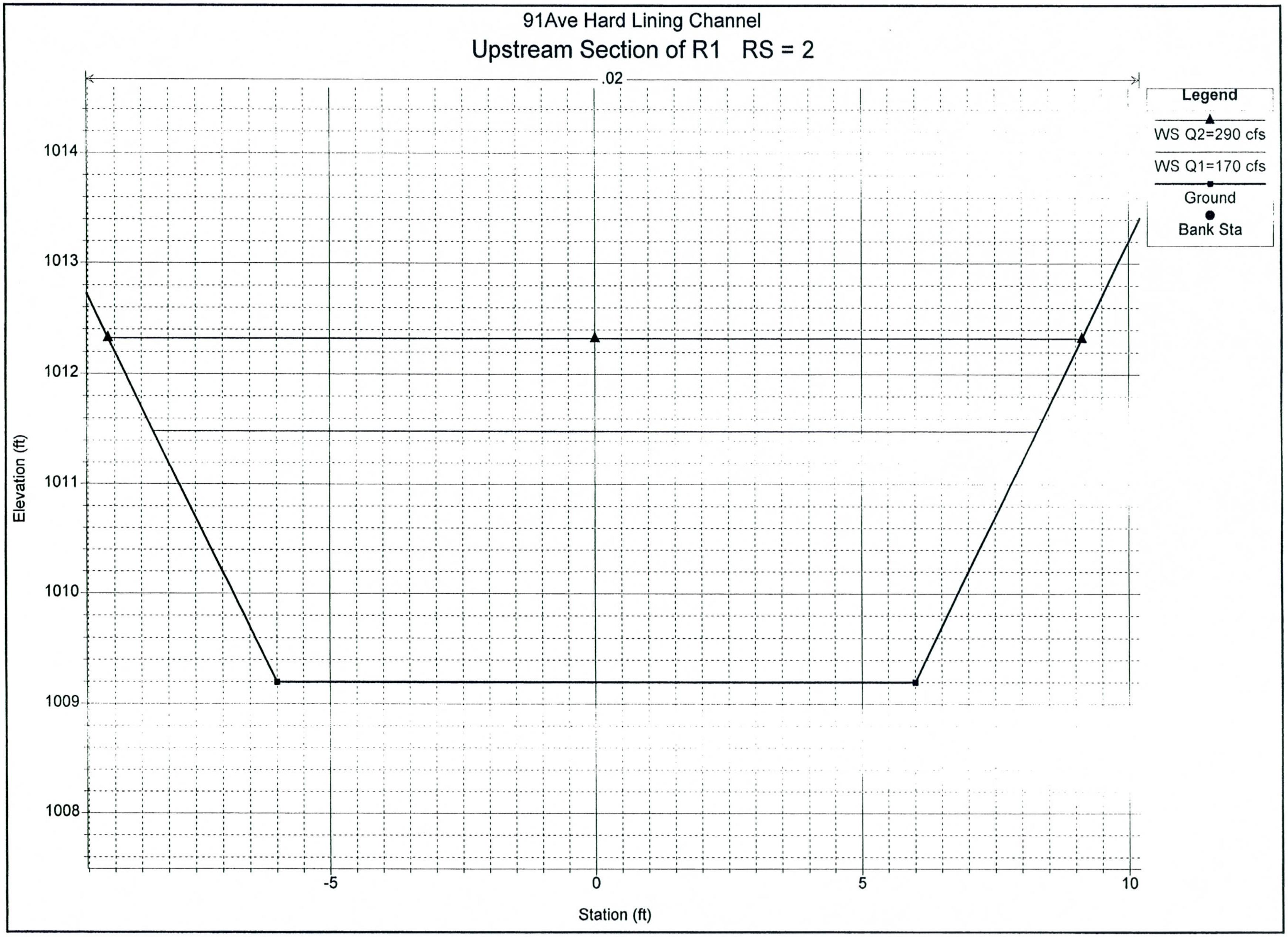
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Albertsons	2	810.00	1008.00	1012.13		1012.88	0.001993	6.95	116.58	36.51	0.69
Albertsons	2	1380.00	1008.00	1013.49		1014.51	0.001992	8.10	170.29	41.98	0.71
Albertsons	1	810.00	1000.00	1004.12	1003.30	1004.87	0.002001	6.96	116.42	36.49	0.69
Albertsons	1	1380.00	1000.00	1005.49	1004.50	1006.51	0.002002	8.12	170.00	41.95	0.71



99th Ave, Alt 1-A-2
Downstream section of R1 RS = 1
.02
Legend
WS Q2=850 cfs
WS Q1=500 cfs
Ground
Bank Sta
1006
1004
1002
1000
Elevation (ft)
-10
-5
0
5
10
Station (ft)

HEC-RAS Plan: 99th Ave River: 99st Ave Reach: Typical

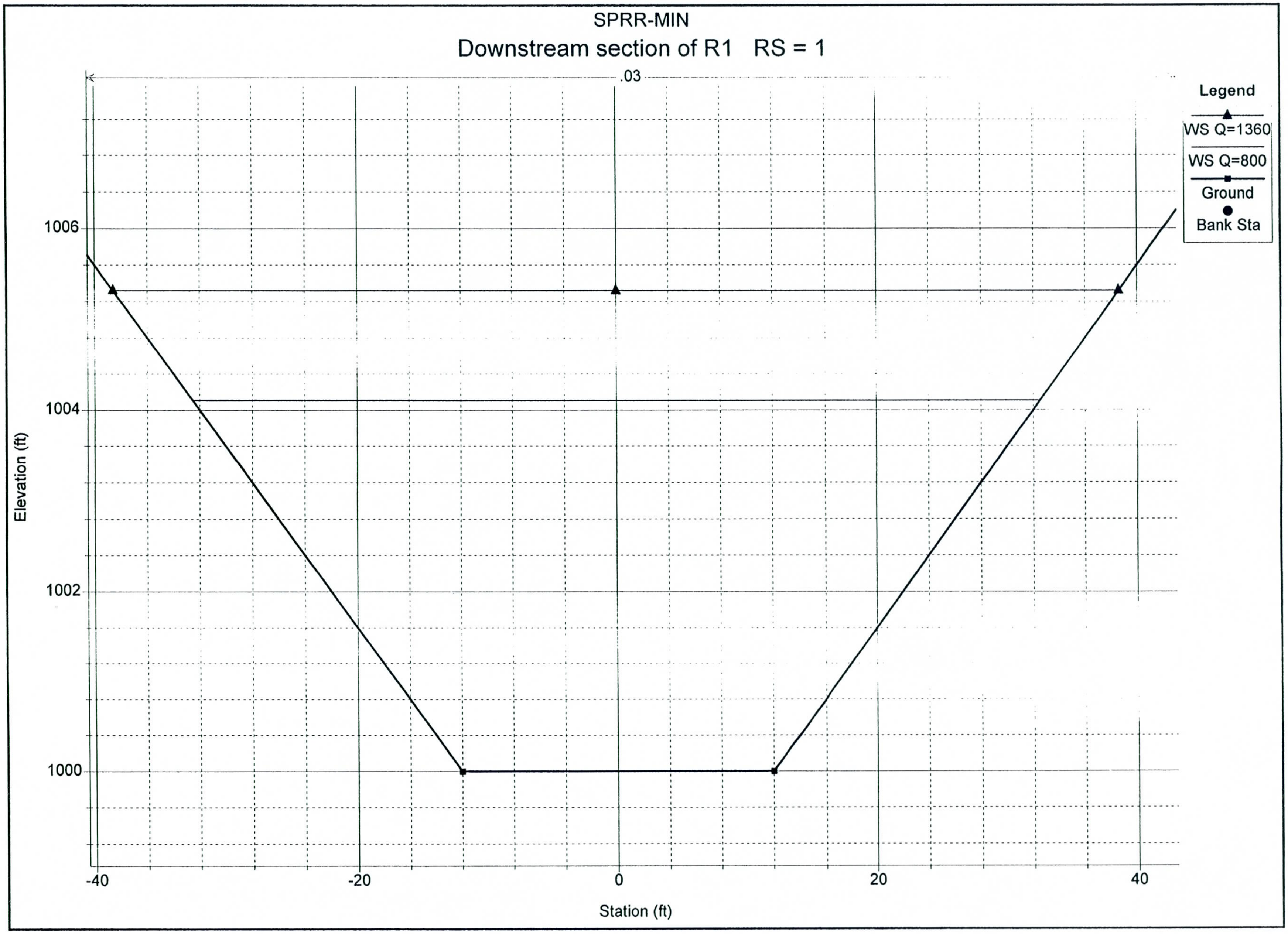
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Typical	2	Q1=500 cfs	500.00	1009.20	1013.46		1014.27	0.002297	7.21	69.34	20.53	0.69
Typical	2	Q2=850 cfs	850.00	1009.20	1014.92		1016.02	0.002290	8.43	100.78	22.00	0.69
Typical	1	Q1=500 cfs	500.00	1000.00	1004.26	1003.41	1005.07	0.002300	7.22	69.30	20.52	0.69
Typical	1	Q2=850 cfs	850.00	1000.00	1005.71	1004.68	1006.82	0.002302	8.45	100.59	22.00	0.70



91Ave Hard Lining Channel
Upstream Section of R1   RS = 2
.02
Legend
WS Q2=290 cfs
WS Q1=170 cfs
Ground
Bank Sta
1014
1013
1012
1011
1010
1009
1008
Elevation (ft)
-5
0
5
10
Station (ft)

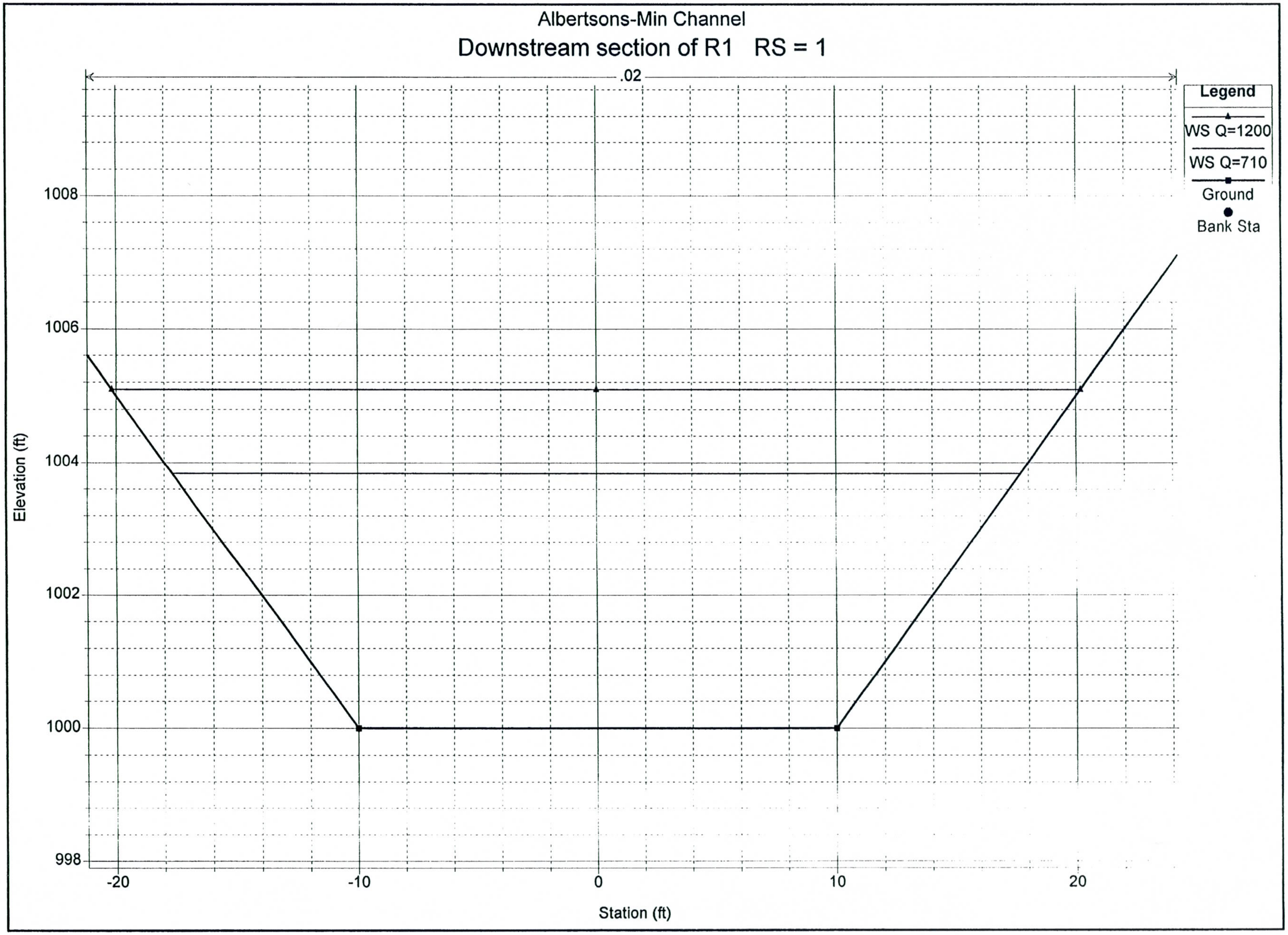
HEC-RAS Plan: 91st Ave River: 91st Ave Reach: Typical

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Typical	2	Q1=170 cfs	170.00	1009.20	1011.49		1011.91	0.002297	5.21	32.65	16.57	0.65
Typical	2	Q2=290 cfs	290.00	1009.20	1012.32		1012.91	0.002293	6.14	47.23	18.25	0.67
Typical	1	Q1=170 cfs	170.00	1000.00	1002.28	1001.74	1002.71	0.002304	5.21	32.62	16.57	0.65
Typical	1	Q2=290 cfs	290.00	1000.00	1003.12	1002.44	1003.71	0.002301	6.15	47.18	18.24	0.67


SPRR-MIN
Downstream section of R1 RS = 1
.03
Legend
WS Q=1360
WS Q=800
Ground
Bank Sta
1006
1004
1002
1000
Elevation (ft)
-40
-20
0
20
40
Station (ft)

HEC-RAS Plan: Channel-Min River: Green Reach: R1

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
R1	2	800.00	1008.00	1012.11		1012.41	0.001994	4.37	183.04	65.09	0.46
R1	2	1360.00	1008.00	1013.32		1013.72	0.001998	5.05	269.45	77.23	0.48
R1	1	800.00	1000.00	1004.11	1002.68	1004.40	0.002001	4.38	182.83	65.06	0.46
R1	1	1360.00	1000.00	1005.32	1003.59	1005.72	0.002003	5.05	269.22	77.20	0.48



Albertsons-Min Channel
Downstream section of R1 RS = 1
.02
Legend
WS Q=1200
WS Q=710
Ground
Bank Sta
1008
1006
1004
1002
1000
998
Elevation (ft)
-20
-10
0
10
20
Station (ft)

HEC-RAS Plan: Albert-Min River: SPRR Channel Reach: Albertsons

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Albertsons	2	710.00	1008.00	1011.84		1012.53	0.001999	6.69	106.15	35.34	0.68
Albertsons	2	1200.00	1008.00	1013.10		1014.04	0.001997	7.80	153.94	40.39	0.70
Albertsons	1	710.00	1000.00	1003.84	1003.05	1004.53	0.002000	6.69	106.13	35.34	0.68
Albertsons	1	1200.00	1000.00	1005.09	1004.15	1006.04	0.002003	7.80	153.78	40.38	0.70

APPENDIX B-2: Hydraulic Computations for Alternative 2

Table
Rating Table for Irregular Channel

Project Description	
Project File	d:\1prj\mfc019\hec-ras\alternat.fm2
Worksheet	Van Buren Street Capacity
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Channel Slope	0.001150 ft/ft

Input Data	Minimum	Maximum	Increment
Water Surface Elevation	10.00	10.20	0.01 ft

Rating Table

Water Surface Elevation (ft)	Wtd. Mannings Coefficient	Discharge (cfs)	Velocity (ft/s)
10.00	0.015	18.69	1.27
10.01	0.015	19.39	1.27
10.02	0.015	20.15	1.26
10.03	0.015	20.99	1.26
10.04	0.015	21.89	1.26
10.05	0.015	22.87	1.26
10.06	0.015	23.91	1.26
10.07	0.015	25.40	1.28
10.08	0.015	26.93	1.30
10.09	0.015	28.50	1.33
10.10	0.015	30.13	1.35
10.11	0.015	32.10	1.38
10.12	0.015	34.13	1.42
10.13	0.015	36.20	1.45
10.14	0.015	38.32	1.48
10.15	0.015	40.49	1.52
10.16	0.015	42.70	1.55
10.17	0.015	44.96	1.58
10.18	0.015	47.27	1.61
10.19	0.015	49.62	1.64
10.20	0.015	52.02	1.67

Cross Section
Cross Section for Irregular Channel

Project Description	
Project File	d:\1prj\mfc019\hec-ras\alternat.fm2
Worksheet	Van Buren Street Capacity
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Section Data		
Wtd. Mannings Coefficient	0.015	
Channel Slope	0.001150	ft/ft
Water Surface Elevation	10.20	ft
Discharge	52.02	cfs

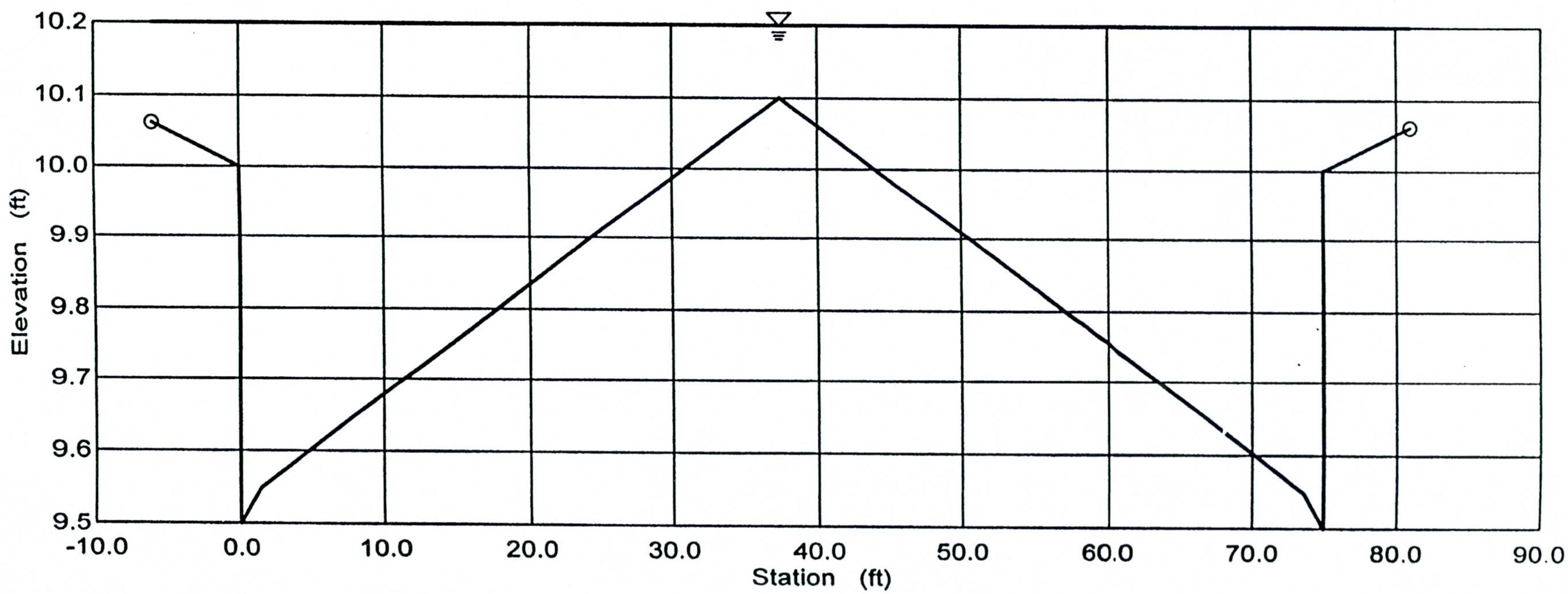


Table
Rating Table for Circular Channel

Project Description	
Project File	d:\1prj\mfc019\hec-ras\alternat.fm2
Worksheet	Storm Drain from Van Buren - Cowden Park
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Diameter

Constant Data	
Mannings Coefficient	0.013
Channel Slope	0.003000 ft/ft

Input Data	Minimum	Maximum	Increment
Discharge	30.00	80.00	10.00 cfs

Rating Table

Discharge (cfs)	Depth (in)	Diameter (in)	Velocity (ft/s)
30.00	33.4	33.44	4.92
40.00	37.2	37.25	5.29
50.00	40.5	40.50	5.59
60.00	43.4	43.36	5.85
70.00	45.9	45.94	6.08
80.00	48.3	48.30	6.29
55		42	

Table
Rating Table for Rectangular Channel

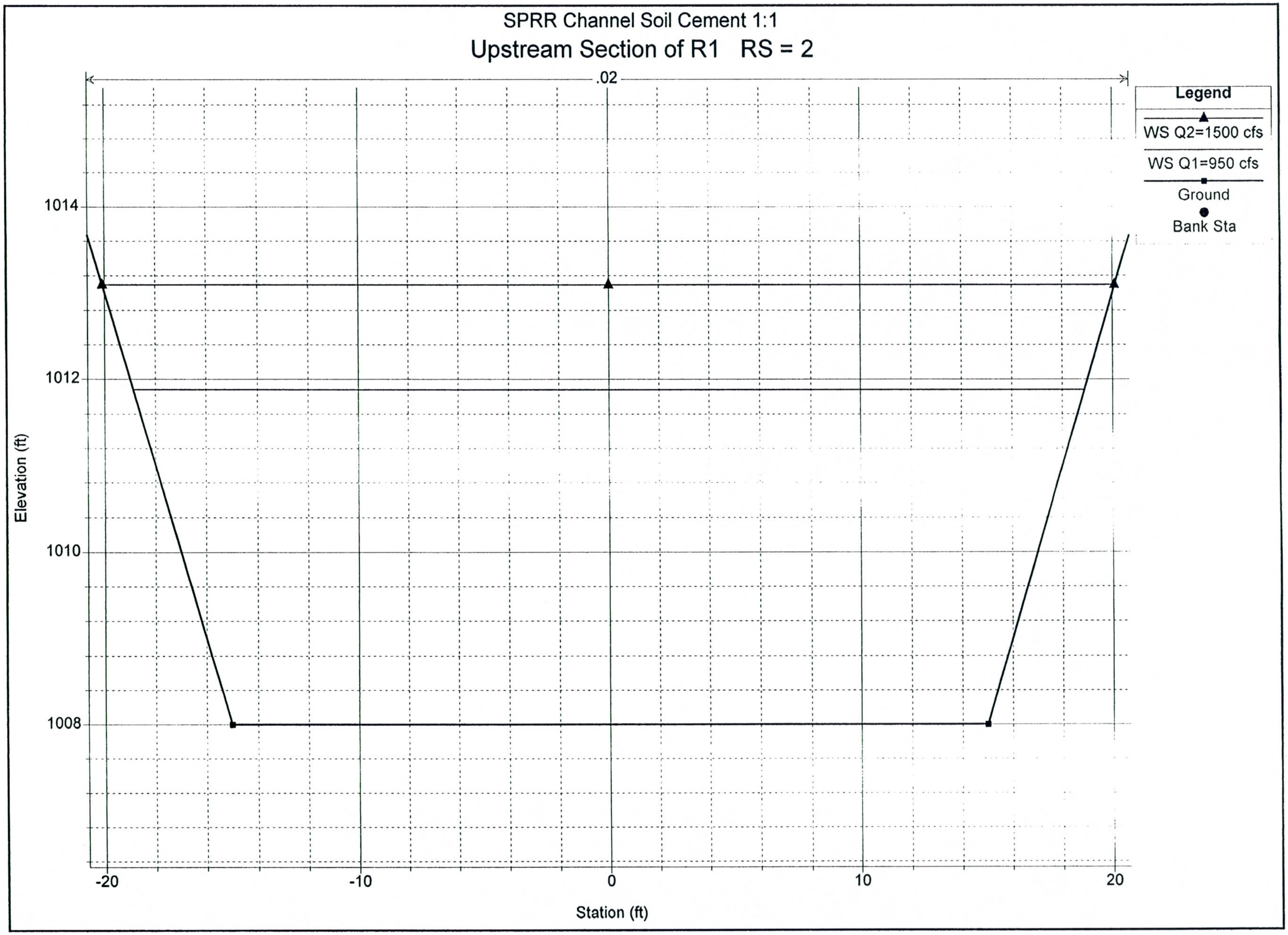
Project Description	
Project File	d:\1prj\mfc019\hec-ras\alternat.fm2
Worksheet	Culvert Crossing 91st Avenue Alter-2
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.013	
Channel Slope	0.002000	ft/ft
Bottom Width	40.00	ft

Input Data	Minimum	Maximum	Increment
Discharge	1,000.00	1,800.00	100.00 cfs

Rating Table

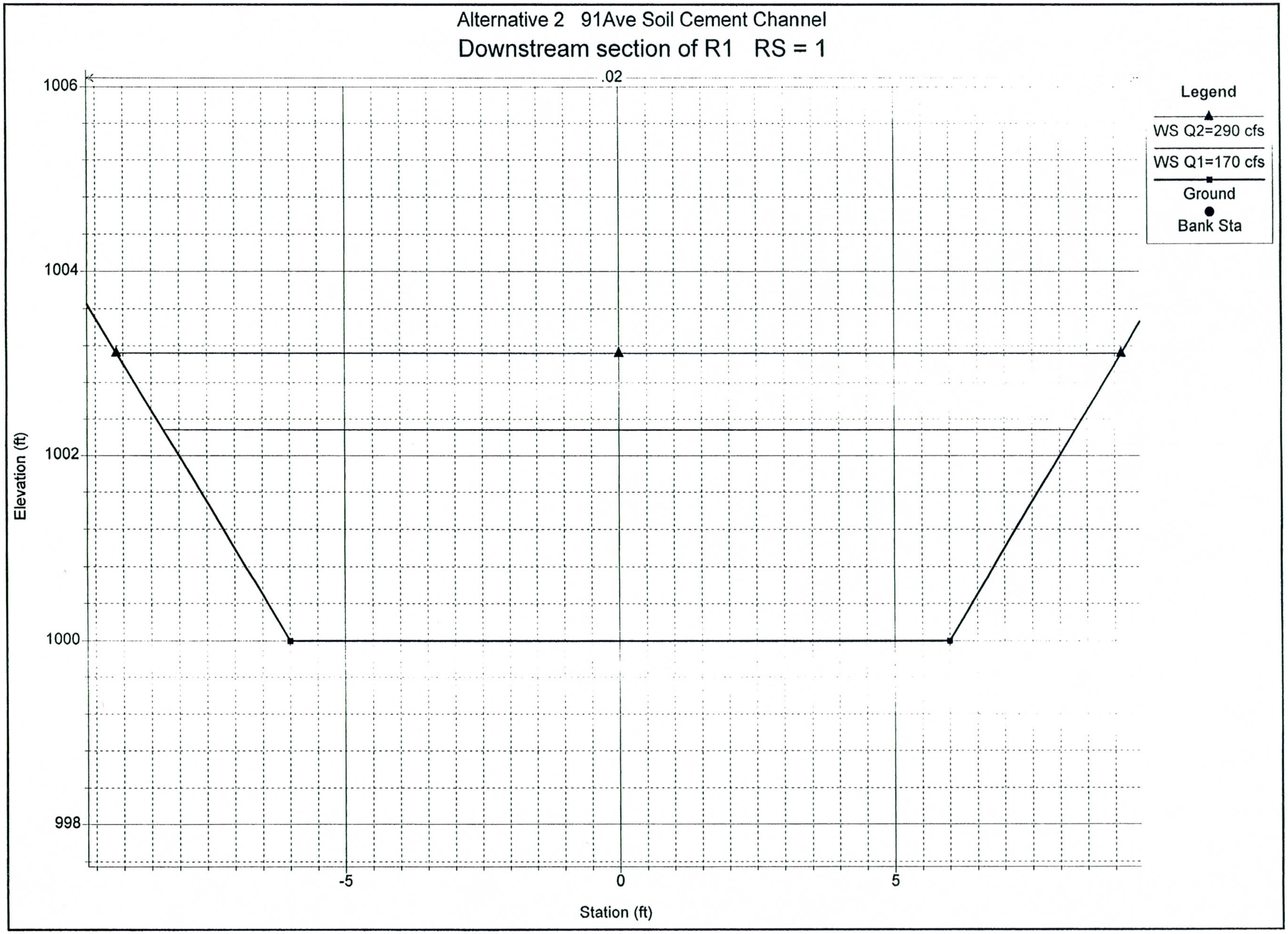
Discharge (cfs)	Depth (ft)	Velocity (ft/s)
1,000.00	2.73	9.16
1,100.00	2.90	9.49
1,200.00	3.06	9.80
1,300.00	3.22	10.09
1,400.00	3.38	10.37
1,500.00	3.53	10.63
1,600.00	3.68	10.88
1,700.00	3.82	11.12
1,800.00	3.96	11.35



SPRR Channel Soil Cement 1:1
Upstream Section of R1 RS = 2
.02
Legend
WS Q2=1500 cfs
WS Q1=950 cfs
Ground
Bank Sta
1014
1012
1010
1008
Elevation (ft)
-20
-10
0
10
20
Station (ft)

HEC-RAS Plan: Soil Cement River: SPRR Flood Contr Reach: typical

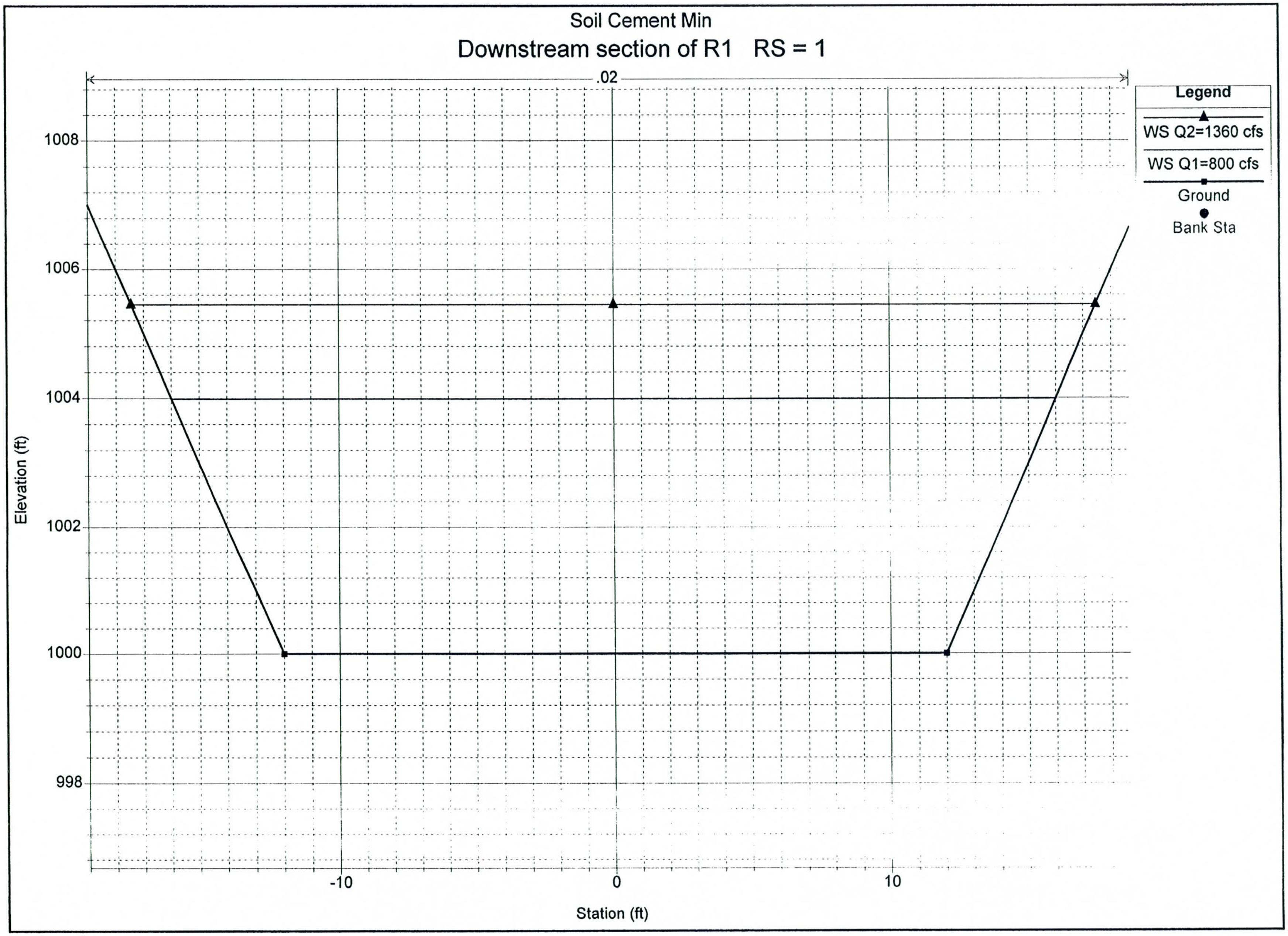
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
typical	2	950.00	1008.00	1011.88		1012.69	0.001999	7.23	131.48	37.76	0.68
typical	2	1500.00	1008.00	1013.09		1014.19	0.001994	8.39	178.70	40.18	0.70
typical	1	950.00	1000.00	1003.88	1003.03	1004.69	0.002000	7.23	131.44	37.76	0.68
typical	1	1500.00	1000.00	1005.09	1004.06	1006.18	0.002001	8.40	178.48	40.17	0.70



Alternative 2 91Ave Soil Cement Channel
Downstream section of R1 RS = 1
.02
1006
1004
1002
1000
998
Elevation (ft)
-5
0
5
Station (ft)
Legend
WS Q2=290 cfs
WS Q1=170 cfs
Ground
Bank Sta

HEC-RAS Plan: 91th Ave River: Green Reach: R1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
R1	2	Q1=170 cfs	170.00	1009.20	1011.49		1011.91	0.002297	5.21	32.65	16.57	0.65
R1	2	Q2=290 cfs	290.00	1009.20	1012.32		1012.91	0.002293	6.14	47.23	18.25	0.67
R1	1	Q1=170 cfs	170.00	1000.00	1002.28	1001.74	1002.71	0.002304	5.21	32.62	16.57	0.65
R1	1	Q2=290 cfs	290.00	1000.00	1003.12	1002.44	1003.71	0.002301	6.15	47.18	18.24	0.67



Soil Cement Min
Downstream section of R1 RS = 1
.02
Legend
WS Q2=1360 cfs
WS Q1=800 cfs
Ground
Bank Sta
Elevation (ft)
1008
1006
1004
1002
1000
998
-10
0
10
Station (ft)

HEC-RAS Plan: Cement min River: SPRR Flood Contr Reach: typical

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
typical	2	800.00	1008.00	1011.99		1012.79	0.001997	7.16	111.75	31.98	0.67
typical	2	1360.00	1008.00	1013.45		1014.57	0.001997	8.47	160.58	34.90	0.70
typical	1	800.00	1000.00	1003.99	1003.10	1004.79	0.002001	7.16	111.68	31.98	0.68
typical	1	1360.00	1000.00	1005.45	1004.34	1006.56	0.002001	8.47	160.49	34.90	0.70

APPENDIX C

Conceptual Cost Estimates

APPENDIX C-1: Conceptual Cost Estimates for Alternative 1

PRIMATECH
ENGINEERS & CONSULTANTS

Project:	Tolleson SPRR and Van Buren Street at 91st Avenue CAR Alternative 1-A: Conceptual Cost Estimate			Project No. FCD 98-23	
ID #	**Item/Description**	**Quantity**	**Units**	**Unit Cost**	**Amount**
1	**Channel along SPRR (Not Including Light Rail)**	**25,100**	**LF**		
	23900 LF Grass Lining Channel - BW=24', TW=79', 5:1(H:V), D=5.5' (including 1' free board)	23,900	LF		
	Grass Channel Lining	54	ACRE	$1,600.00	$86,909
	landscape and Irrigation	54	AC	$15,000.00	$814,773
	Earthwork/Channel Excavation	255,287	CY	$3.50	$893,506
	Concrete Box Culvert: 5-10'x4'x85 @ 83st Ave	425	CY	$350.00	$148,750
	Concrete Box Culvert: 5-10'x4'x85 @ 91st Ave	425	CY	$350.00	$148,750
	Concrete Box Culvert: 5-10'x4'x85 @ 99th Ave	425	CY	$350.00	$148,750
	Concrete Box Culvert: 5-10'x4'x85 @ 107th Ave	425	CY	$350.00	$148,750
	Concrete Box Culvert: 5-10'x4'x85 @ 115th Ave	425	CY	$350.00	$148,750
	Concrete Box Culvert: 5-10'x4'x60 @ 87th Ave	300	CY	$350.00	$105,000
	Concrete Box Culvert: 5-10'x4'x60 @ 95th Ave	300	CY	$350.00	$105,000
	Concrete Box Culvert: 5-10'x4'x60 @ Marshall Ave	300	CY	$351.00	$105,300
	1200 LF Concrete Lining Channel @ Albertsons - BW=20', TW=40.4', 2:1(H:V), D=5.1' (including 1' free board)	1,200	LF		
	Concrete Channel Lining	5,733	SY	$40.00	$229,333
	Earthwork/Channel Excavation	8,533	CY	$3.50	$29,867
	Safety Rail	1,200	LF	$12.00	$14,400
	Land Acquisition Cost	58	AC	$30,000.00	$1,728,650
	Sub-Total	25,100	LF	$193.49	**$4,856,488**
2	**Storm Drain in Van Buren Street**	**2,600**	**LF**		
	60" RGRCP	2,600	LF	$220.00	$572,000
	Sub-Total				**$572,000**
3	**Channel along 91st Avenue**	**2,600**	**LF**		
	Grass Channel Lining - Trap Channel BW=16', TW=46', 5:1(H:V), D=3' (including 1' free board)	3.3	ACRE	$1,600.00	$5,348
	Earthwork/Channel Excavation	8,956	CY	$3.50	$31,344
	landscape and Irrigation	3.3	AC	$10,000.00	$33,000
	Land Acquisition Cost	3.3	AC	$30,000.00	$99,000
	Sub-Total	2,600	LF	$64.88	**$168,692**
4	**Channel aong 99th Avenue**	**2,600**	**LF**		
	Grass Channel Lining - Trap Channel BW=26', TW=66', 5:1(H:V), D=4' (including 1' free board)	4.5	ACRE	$1,600.00	$7,258

PRIMATECH
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Project: **Tolleson SPRR and Van Buren Street at 91st Avenue CAR**
Alternative 1-A: Conceptual Cost Estimate Project No. FCD 98-23

ID #	Item/Description	Quantity	Units	Unit Cost	Amount
	Earthwork/Channel Excavation	15,407	CY	$3.50	$53,926
	landscape and Irrigation	4.5	AC	$10,000.00	$45,000
	Land Acquisition Cost	4.5	AC	$30,000.00	$135,000
	Sub-Total	2,600	LF	$92.76	**$241,184**
5	**Retention Basin at 83rd Ave and SPRR**	**53**	**AC-FT**		
	Earthwork/Excavation	85,507	CY	$3.00	$256,520
	landscape and Irrigation	5.5	AC	$11,600.00	$63,800
	Land Acquisition Cost	5.5	AC	$30,000.00	$165,000
	Sub-Total				**$485,320**
6	**Retention Basin at 91st Ave and SPRR**	**2**	**AC-FT**		
	Earthwork/Excavation	3,227	CY	$3.00	$9,680
	landscape and Irrigation	1.0	AC	$11,600.00	$11,600
	Land Acquisition Cost	1.0	AC	$30,000.00	$30,000
	Sub-Total				**$51,280**
7	**Retention Basin at 99th Ave and SPRR**	**120**	**AC-FT**		
	Earthwork/Excavation	193,600	CY	$3.00	$580,800
	landscape and Irrigation	10.0	AC	$11,600.00	$116,000
	Land Acquisition Cost	10.0	AC	$30,000.00	$300,000
	Sub-Total				**$996,800**
8	**Retention Basin at 107th Ave and SPRR**	**40**	**AC-FT**		
	Earthwork/Excavation	64,533	CY	$3.00	$193,600
	landscape and Irrigation	4.2	AC	$11,600.00	$48,720
	Land Acquisition Cost	4.2	AC	$30,000.00	$126,000
	Sub-Total				**$368,320**
9	**Retention Basin at 115th Ave and SPRR**	**39**	**AC-FT**		
	Earthwork/Excavation	62,920	CY	$3.00	$188,760
	landscape and Irrigation	4.1	AC	$11,600.00	$47,560
	Land Acquisition Cost	4.1	AC	$30,000.00	$123,000
	Sub-Total				**$359,320**
10	**Light Rail From 83rd Ave to 107th Ave**	**17,200**	**LF**		
	Land Acquisition Cost	22.5	AC	$30,000.00	$675,207
	Sub-Total				**$675,207**
	Sub-Total: Tolleson Drainage Improvement Alternative 1-A				**$8,774,610**
	Engineering and Contingencies	25%			$2,193,653

PRIMATECH
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Project:	Tolleson SPRR and Van Buren Street at 91st Avenue CAR Alternative 1-A: Conceptual Cost Estimate			Project No. FCD 98-23	
ID #	**Item/Description**	**Quantity**	**Units**	**Unit Cost**	**Amount**
	Total: Tolleson Drainage Improvement Alternative 1-A				**$10,968,263**

PRIMATECH
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Project: **Tolleson SPRR and Van Buren Street at 91st Avenue CAR**
Alternative 1-B: Conceptual Cost Estimate Project No. FCD 98-23

ID #	Item/Description	Quantity	Units	Unit Cost	Amount
1	**Channel along SPRR (Not Including Light Rail)**	**25,100**	**LF**		
	Soil Cement Channel Lining - Trap Channel BW=30', TW=40', 1:1(H:V), D=5', (including 1' free board)	133,867	CY	$12.00	$1,606,400
	Earthwork/Channel Excavation	296,552	CY	$3.50	$1,037,931
	Concrete Box Culvert: 5-10'x4'x85 @ 83st Ave	425	CY	$350.00	$148,750
	Concrete Box Culvert: 4-10'x4'x85 @ 91st Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x85 @ 99th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x85 @ 107th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x85 @ 115th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x60 @ 87th Ave	240	CY	$350.00	$84,000
	Concrete Box Culvert: 4-10'x4'x60 @ 95th Ave	240	CY	$350.00	$84,000
	Concrete Box Culvert: 4-10'x4'x60 @ Marshall Ave	240	CY	$351.00	$84,240
	Safety Rail	25,100	LF	$12.00	$301,200
	Land Acquisition Cost	38	ACRE	$30,000.00	$1,140,909
	Sub-Total	25,100	LF	$197.75	**$4,963,430**
2	**Storm Drain in Van Buren Street**	**2,600**	**LF**		
	60" RGRCP	2,600	LF	$220.00	$572,000
	Sub-Total				**$572,000**
3	**Channel along 91st Avenue**	**2,600**	**LF**		
	Concrete Channel Lining - Trap Channel BW=12', TW=19', 1:1(H:V), D=3.5', (including 1' free board)	6,356	SY	$30.00	$190,667
	Earthwork/Channel Excavation	7,896	CY	$3.50	$27,637
	Land Acquisition Cost	1.7	ACRE	$30,000.00	$51,928
	Sub-Total	2,600	LF	$103.94	**$270,232**
4	**Channel aong 99th Avenue**	**2,600**	**LF**		
	Concrete Channel Lining - Trap Channel BW=12', TW=23', 1:1(H:V), D=5.3', (including 1' free board)	7,800	SY	$30.00	$234,000
	Earthwork/Channel Excavation	10,207	CY	$3.50	$35,726
	Safety Rail	2,600	LF	$12.00	$31,200
	Land Acquisition Cost	2.0	AC	$30,000.00	$59,091
	Sub-Total	2,600	LF	$138.47	**$360,017**
5	**Retention Basin at 83rd Ave and SPRR**	**53**	**AC-FT**		
	Earthwork/Excavation	85,507	CY	$3.00	$256,520
	landscape and Irrigation	5.5	AC	$11,600.00	$63,800

PRIMATECH
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Project:	**Tolleson SPRR and Van Buren Street at 91st Avenue CAR**				
	Alternative 1-B: Conceptual Cost Estimate			Project No. FCD 98-23	
ID #	**Item/Description**	**Quantity**	**Units**	**Unit Cost**	**Amount**
	Land Acquisition Cost	5.5	AC	$30,000.00	$165,000
	Sub-Total				**$485,320**
6	**Retention Basin at 91st Ave and SPRR**	**2**	**AC-FT**		
	Earthwork/Excavation	3,227	CY	$3.00	$9,680
	landscape and Irrigation	1.0	AC	$11,600.00	$11,600
	Land Acquisition Cost	1.0	AC	$30,000.00	$30,000
	Sub-Total				**$51,280**
7	**Retention Basin at 99th Ave and SPRR**	**120**	**AC-FT**		
	Earthwork/Excavation	193,600	CY	$3.00	$580,800
	landscape and Irrigation	10.0	AC	$11,600.00	$116,000
	Land Acquisition Cost	10.0	AC	$30,000.00	$300,000
	Sub-Total				**$996,800**
8	**Retention Basin at 107th Ave and SPRR**	**40**	**AC-FT**		
	Earthwork/Excavation	64,533	CY	$3.00	$193,600
	landscape and Irrigation	4.2	AC	$11,600.00	$48,720
	Land Acquisition Cost	4.2	AC	$30,000.00	$126,000
	Sub-Total				**$368,320**
9	**Retention Basin at 115th Ave and SPRR**	**39**	**AC-FT**		
	Earthwork/Excavation	62,920	CY	$3.00	$188,760
	landscape and Irrigation	4.1	AC	$11,600.00	$47,560
	Land Acquisition Cost	4.1	AC	$30,000.00	$123,000
	Sub-Total				**$359,320**
10	**Light Rail From 83rd Ave to 107th Ave**	**17,200**	**LF**		
	Land Acquisition Cost	22.5	AC	$30,000.00	$675,207
	Sub-Total				**$675,207**
	Sub-Total: Tolleson Drainage Improvement Alternative 1-B				**$9,101,926**
	Engineering and Contingencies	25%			$2,275,481
	Total: Tolleson Drainage Improvement Alternative 1-B				**$11,377,407**

PRIMATECH
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Project: **Tolleson SPRR and Van Buren Street at 91st Avenue CAR**
Alternative 1-C: Conceptual Cost Estimate
Project No. FCD 98-23

ID #	Item/Description	Quantity	Units	Unit Cost	Amount
1	**Channel along SPRR (Not Including Light Rail)**	**25,100**	**LF**		
	23900 LF Grass Lining Channel - BW=24', TW=75', 5:1(H:V), D=5.1' (including 1' free board)	23,900	LF		
	Grass Channel Lining	52	ACRE	$1,600.00	$83,398
	landscape and Irrigation	52	AC	$15,000.00	$781,853
	Earthwork/Channel Excavation	245,373	CY	$3.50	$858,807
	Concrete Box Culvert: 5-10'x4'x85 @ 83st Ave	425	CY	$350.00	$148,750
	Concrete Box Culvert: 4-10'x4'x85 @ 91st Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x85 @ 99th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x85 @ 107th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x85 @ 115th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x60 @ 87th Ave	240	CY	$350.00	$84,000
	Concrete Box Culvert: 4-10'x4'x60 @ 95th Ave	240	CY	$350.00	$84,000
	Concrete Box Culvert: 4-10'x4'x60 @ Marshall Ave	240	CY	$351.00	$84,240
	1200 LF Concrete Lining Channel @ Albertsons - BW=20', TW=39.3', 2:1(H:V), D=4.8' (including 1' free board)	1,200	LF		
	Concrete Channel Lining	5,533	SY	$40.00	$221,333
	Earthwork/Channel Excavation	8,133	CY	$3.50	$28,467
	Safety Rail	1,200	LF	$12.00	$14,400
	Land Acquisition Cost	58	AC	$30,000.00	$1,728,650
	Sub-Total	25,100	LF	$183.02	**$4,593,898**
2	**Storm Drain in Van Buren Street**	**2,600**	**LF**		
	60" RGRCP	2,600	LF	$220.00	$572,000
	Sub-Total				**$572,000**
3	**Channel along 91st Avenue**	**2,600**	**LF**		
	Grass Channel Lining - Trap Channel BW=16', TW=46', 5:1(H:V), D=3' (including 1' free board)	3.3	ACRE	$1,600.00	$5,348
	Earthwork/Channel Excavation	8,956	CY	$3.50	$31,344
	landscape and Irrigation	3.3	AC	$10,000.00	$33,000
	Land Acquisition Cost	3.3	AC	$30,000.00	$99,000
	Sub-Total	2,600	LF	$64.88	**$168,692**
4	**Channel aong 99th Avenue**	**2,600**	**LF**		
	Grass Channel Lining - Trap Channel BW=26', TW=66', 5:1(H:V), D=4' (including 1' free board)	4.5	ACRE	$1,600.00	$7,258

PRIMATECH
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Project: Tolleson SPRR and Van Buren Street at 91st Avenue CAR
Alternative 1-C: Conceptual Cost Estimate
Project No. FCD 98-23

ID #	Item/Description	Quantity	Units	Unit Cost	Amount
	Earthwork/Channel Excavation	15,407	CY	$3.50	$53,926
	landscape and Irrigation	4.5	AC	$10,000.00	$45,000
	Land Acquisition Cost	4.5	AC	$30,000.00	$135,000
	Sub-Total	2,600	LF	$92.76	**$241,184**
5	**Retention Basin at 83rd Ave and SPRR**	**88**	**AC-FT**		
	Earthwork/Excavation	141,973	CY	$3.00	$425,920
	landscape and Irrigation	8.0	AC	$11,600.00	$92,800
	Land Acquisition Cost	8.0	AC	$30,000.00	$240,000
	Sub-Total				**$758,720**
6	**Retention Basin at 91st Ave and SPRR**	**7**	**AC-FT**		
	Earthwork/Excavation	11,293	CY	$3.00	$33,880
	landscape and Irrigation	2.0	AC	$11,600.00	$23,200
	Land Acquisition Cost	2.0	AC	$30,000.00	$60,000
	Sub-Total				**$117,080**
7	**Retention Basin at 99th Ave and SPRR**	**124**	**AC-FT**		
	Earthwork/Excavation	200,053	CY	$3.00	$600,160
	landscape and Irrigation	10.0	AC	$11,600.00	$116,000
	Land Acquisition Cost	10.0	AC	$30,000.00	$300,000
	Sub-Total				**$1,016,160**
8	**Retention Basin at 107th Ave and SPRR**	**78**	**AC-FT**		
	Earthwork/Excavation	125,840	CY	$3.00	$377,520
	landscape and Irrigation	7.0	AC	$11,600.00	$81,200
	Land Acquisition Cost	7.0	AC	$30,000.00	$210,000
	Sub-Total				**$668,720**
9	**Retention Basin at 115th Ave and SPRR**	**27**	**AC-FT**		
	Earthwork/Excavation	43,560	CY	$3.00	$130,680
	landscape and Irrigation	3.5	AC	$11,600.00	$40,600
	Land Acquisition Cost	3.5	AC	$30,000.00	$105,000
	Sub-Total				**$276,280**
10	**Light Rail From 83rd Ave to 107th Ave**	**17,200**	**LF**		
	Land Acquisition Cost	22.5	AC	$30,000.00	$675,207
	Sub-Total				**$675,207**
	Sub-Total: Tolleson Drainage Improvement Alternative 1-C				**$9,087,940**
	Engineering and Contingencies	25%			$2,271,985

PRIMATECH
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Project:	Tolleson SPRR and Van Buren Street at 91st Avenue CAR Alternative 1-C: Conceptual Cost Estimate			Project No. FCD 98-23	
ID #	**Item/Description**	**Quantity**	**Units**	**Unit Cost**	**Amount**
	Total: Tolleson Drainage Improvement Alternative 1-C				**$11,359,925**

PRIMATECH
ENGINEERS & CONSULTANTS

7/26/99

Project:	Tolleson SPRR and Van Buren Street at 91st Avenue CAR Alternative 1-D: Conceptual Cost Estimate				Project No. FCD 98-24	
ID #	**Item/Description**	**Quantity**	**Units**	**Unit Cost**	**Amount**	**Jurisdiction**
1	**Channel along SPRR (Not Including Light Rail)**	**25,100**	**LF**			**68% in Tolleson**
	23900 LF Grass Lining Channel - BW=24', TW=79', 5:1(H:V), D=5.5' (including 1' free board)	23,900	LF			66% in Tolleson
	Grass Channel Lining	54	ACRE	$1,600.00	$86,909	66% in Tolleson
	landscape and Irrigation	54	AC	$15,000.00	$814,773	66% in Tolleson
	Earthwork/Channel Excavation	255,287	CY	$3.50	$893,506	66% in Tolleson
	Concrete Box Culvert: 5-10'x4'x85 @ 83st Ave	425	CY	$350.00	$148,750	Tolleson
	Concrete Box Culvert: 5-10'x4'x85 @ 91st Ave	425	CY	$350.00	$148,750	Tolleson
	Concrete Box Culvert: 5-10'x4'x85 @ 99th Ave	425	CY	$350.00	$148,750	Tolleson
	Concrete Box Culvert: 5-10'x4'x85 @ 107th Ave	425	CY	$350.00	$148,750	50% in Tolleson
	Concrete Box Culvert: 5-10'x4'x85 @ 115th Ave	425	CY	$350.00	$148,750	out of Tolleson
	Concrete Box Culvert: 5-10'x4'x60 @ 87th Ave	300	CY	$350.00	$105,000	Tolleson
	Concrete Box Culvert: 5-10'x4'x60 @ 95th Ave	300	CY	$350.00	$105,000	Tolleson
	Concrete Box Culvert: 5-10'x4'x60 @ Marshall Ave	300	CY	$351.00	$105,300	out of Tolleson
	1200 LF Concrete Lining Channel @ Albertsons - BW=20', TW=40.4', 2:1(H:V), D=5.1' (including 1' free board)	1,200	LF			Tolleson
	Concrete Channel Lining	5,733	SY	$40.00	$229,333	Tolleson
	Earthwork/Channel Excavation	8,533	CY	$3.50	$29,867	Tolleson
	Safety Rail	1,200	LF	$12.00	$14,400	Tolleson
	Land Acquisition Cost	58	AC	$30,000.00	$1,728,650	68% in Tolleson
	Sub-Total	25,100	LF	$193.49	**$4,856,488**	
2	**Storm Drain in Van Buren Street**	**2,600**	**LF**			
	60" RGRCP	2,600	LF	$220.00	$572,000	
	Sub-Total				**$572,000**	Tolleson
3	**Channel along 91st Avenue**	**2,600**	**LF**			
	Grass Channel Lining - Trap Channel BW=16', TW=46', 5:1(H:V), D=3' (including 1' free board)	3.3	ACRE	$1,600.00	$5,348	
	Earthwork/Channel Excavation	8,956	CY	$3.50	$31,344	
	landscape and Irrigation	3.3	AC	$10,000.00	$33,000	
	Land Acquisition Cost	3.3	AC	$30,000.00	$99,000	
	Sub-Total	2,600	LF	$64.88	**$168,692**	Tolleson

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Project: **Tolleson SPRR and Van Buren Street at 91st Avenue CAR**
Alternative 1-D: Conceptual Cost Estimate Project No. FCD 98-24

ID #	Item/Description	Quantity	Units	Unit Cost	Amount	Jurisdiction
4	**Channel aong 99th Avenue**	**2,600**	**LF**			
	Grass Channel Lining - Trap Channel BW=26', TW=66', 5:1(H:V), D=4' (including 1' free board)	4.5	ACRE	$1,600.00	$7,258	
	Earthwork/Channel Excavation	15,407	CY	$3.50	$53,926	
	landscape and Irrigation	4.5	AC	$10,000.00	$45,000	
	Land Acquisition Cost	4.5	AC	$30,000.00	$135,000	
	Sub-Total	2,600	LF	$92.76	**$241,184**	Tolleson
5	**Retention Basin at Park Site at 86th Ave and Van Buren**	**46**	**AC-FT**			
	Earthwork/Excavation	74,213	CY	$3.00	$222,640	
	landscape and Irrigation	7.0	AC	$11,600.00	$81,200	
	Land Acquisition Cost (City Owned)	7.0	AC	$0.00	$0	
	Sub-Total				**$303,840**	Tolleson
6	**Retention Basin at 83rd Ave and SPRR**	**53**	**AC-FT**			
	Earthwork/Excavation	85,507	CY	$3.00	$256,520	
	landscape and Irrigation	5.5	AC	$11,600.00	$63,800	
	Land Acquisition Cost	5.5	AC	$30,000.00	$165,000	
	Sub-Total				**$485,320**	Tolleson
7	**Retention Basin at 99th Ave and SPRR**	**85**	**AC-FT**			
	Earthwork/Excavation	137,133	CY	$3.00	$411,400	
	landscape and Irrigation	7.0	AC	$11,600.00	$81,200	
	Land Acquisition Cost	7.0	AC	$30,000.00	$210,000	
	Sub-Total				**$702,600**	Tolleson
8	**Retention Basin at 107th Ave and SPRR**	**38**	**AC-FT**			
	Earthwork/Excavation	61,307	CY	$3.00	$183,920	
	landscape and Irrigation	4.0	AC	$11,600.00	$46,400	
	Land Acquisition Cost	4.0	AC	$30,000.00	$120,000	
	Sub-Total				**$350,320**	Tolleson
9	**Retention Basin at 115th Ave and SPRR**	**38**	**AC-FT**			
	Earthwork/Excavation	61,307	CY	$3.00	$183,920	
	landscape and Irrigation	4.0	AC	$11,600.00	$46,400	

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Project: Tolleson SPRR and Van Buren Street at 91st Avenue CAR
Alternative 1-D: Conceptual Cost Estimate

Project No. FCD 98-24

ID #	Item/Description	Quantity	Units	Unit Cost	Amount	Jurisdiction
	Land Acquisition Cost	4.0	AC	$30,000.00	$120,000	
	Sub-Total				**$350,320**	out of Tolleson
10	**Light Rail From 83rd Ave to 107th Ave**	**17,200**	**LF**			
	Land Acquisition Cost	22.5	AC	$30,000.00	$675,207	
	Sub-Total				**$675,207**	Tolleson
	Sub-Total: Tolleson Drainage Improvement Alternative 1-D				**$8,705,970**	
	Engineering and Contingencies	25%			$2,176,493	
	Total: Tolleson Drainage Improvement Alternative 1-D				**$10,882,463**	
	Sub-Total of Alternative 1-D in City of Tolleson				$6,863,693.61	Tolleson
	Engineering and Contingencies	25%			$1,715,923	
	Total: Alternative 1-D in City of Tolleson				**$8,579,617**	Tolleson

APPENDIX C-2: Conceptual Cost Estimates for Alternative 2

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Project: **Tolleson SPRR and Van Buren Street at 91st Avenue CAR**
Alternative 2-A: Conceptual Cost Estimate Project No. FCD 98-23

ID #	Item/Description	Quantity	Units	Unit Cost	Amount
1	**Channel along SPRR**	**19,800**	**LF**		
	23900 LF Grass Lining Channel - BW=24', TW=79', 5:1(H:V), D=5.5' (including 1' free board)	18,600	LF		
	Grass Channel Lining	42	ACRE	$1,600.00	$67,636
	landscape and Irrigation	42	AC	$15,000.00	$634,091
	Earthwork/Channel Excavation	198,676	CY	$3.50	$695,364
	Concrete Box Culvert: 3-10'x4'x85 @ 91st Ave	255	CY	$350.00	$89,250
	Concrete Box Culvert: 5-10'x4'x85 @ 99th Ave	425	CY	$350.00	$148,750
	Concrete Box Culvert: 5-10'x4'x85 @ 107th Ave	425	CY	$350.00	$148,750
	Concrete Box Culvert: 5-10'x4'x85 @ 115th Ave	425	CY	$350.00	$148,750
	Concrete Box Culvert: 5-10'x4'x60 @ 95th Ave	300	CY	$350.00	$105,000
	Concrete Box Culvert: 5-10'x4'x60 @ Marshall Ave	300	CY	$351.00	$105,300
	1200 LF Concrete Lining Channel @ Albertsons - BW=30', TW=51', 2:1(H:V), D=5.2' (including 1' free board)	1,200	LF		
	Concrete Channel Lining	7,067	SY	$40.00	$282,667
	Earthwork/Channel Excavation	11,333	CY	$3.50	$39,667
	Safety Rail	1,200	LF	$12.00	$14,400
	Land Acquisition Cost	45	AC	$30,000.00	$1,363,636
	Sub-Total	19,800	LF	$194.10	**$3,843,261**
2	**Storm Drain in Van Buren Street**	**1,600**	**LF**		
	42" RGRCP	1,600	LF	$150.00	$240,000
	Sub-Total				**$240,000**
3	**Channel along 91st Avenue**	**2,600**	**LF**		
	Grass Channel Lining - Trap Channel BW=16', TW=46', 5:1(H:V), D=3' (including 1' free board)	3.3	ACRE	$1,600.00	$5,348
	Earthwork/Channel Excavation	8,956	CY	$3.50	$31,344
	landscape and Irrigation	3.3	AC	$10,000.00	$33,000
	Land Acquisition Cost	3.3	AC	$30,000.00	$99,000
	Sub-Total	2,600	LF	$64.88	**$168,692**
4	**Retention Basin at Cowden Park**	**19**	**AC-FT**		
	Earthwork/Excavation	30,653	CY	$3.00	$91,960
	landscape and Irrigation	6.0	AC	$11,600.00	$69,600
	Land Acquisition Cost (City Owned)	6.0	AC	$0.00	$0
	Sub-Total				**$161,560**

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Project: Tolleson SPRR and Van Buren Street at 91st Avenue CAR
Alternative 2-A: Conceptual Cost Estimate
Project No. FCD 98-23

ID #	Item/Description	Quantity	Units	Unit Cost	Amount
5	**Retention Basin at 99th Ave and SPRR**	**35**	**AC-FT**		
	Earthwork/Excavation	56,467	CY	$3.00	$169,400
	landscape and Irrigation	4.0	AC	$11,600.00	$46,400
	Land Acquisition Cost	4.0	AC	$30,000.00	$120,000
	Sub-Total				**$335,800**
6	**Retention Basin at 107th Ave and SPRR**	**38**	**AC-FT**		
	Earthwork/Excavation	61,307	CY	$3.00	$183,920
	landscape and Irrigation	4.0	AC	$11,600.00	$46,400
	Land Acquisition Cost	4.0	AC	$30,000.00	$120,000
	Sub-Total				**$350,320**
7	**Retention Basin at 115th Ave and SPRR**	**43**	**AC-FT**		
	Earthwork/Excavation	69,373	CY	$3.00	$208,120
	landscape and Irrigation	4.5	AC	$3,000.00	$13,500
	Land Acquisition Cost	4.5	AC	$30,000.00	$135,000
	Sub-Total				**$356,620**
	Sub-Total: Tolleson Drainage Improvement Alternative 2-A				**$5,456,253**
	Engineering and Contingencies	25%			$1,364,063
	Total: Tolleson Drainage Improvement Alternative 2-A				**$6,820,317**

PRIMATECH
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Project: **Tolleson SPRR and Van Buren Street at 91st Avenue CAR**
Alternative 2-B: Conceptual Cost Estimate Project No. FCD 98-23

ID #	Item/Description	Quantity	Units	Unit Cost	Amount
1	**Channel along SPRR**	**19,800**	**LF**		
	Soil Cement Channel Lining - Trap Channel BW=30', TW=40', 1:1(H:V), D=5', (including 1' free board)	105,600	CY	$12.00	$1,267,200
	Earthwork/Channel Excavation	233,933	CY	$3.50	$818,767
	Concrete Box Culvert: 3-10'x4'x85 @ 91st Ave	255	CY	$350.00	$89,250
	Concrete Box Culvert: 4-10'x4'x85 @ 99th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x85 @ 107th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x85 @ 115th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x60 @ 95th Ave	240	CY	$350.00	$84,000
	Concrete Box Culvert: 4-10'x4'x60 @ Marshall Ave	240	CY	$350.00	$84,000
	Safety Rail	19,800	LF	$12.00	$237,600
	Land Acquisition Cost	30	ACRE	$30,000.00	$900,000
	Sub-Total	19,800	LF	$193.83	**$3,837,817**
2	**Storm Drain in Van Buren Street**	**1,600**	**LF**		
	42" RGRCP	1,600	LF	$150.00	$240,000
	Sub-Total				**$240,000**
3	**Channel along 91st Avenue**	**2,600**	**LF**		
	Concrete Channel Lining - Trap Channel BW=12', TW=19', 1:1(H:V), D=3.5', (including 1' free board)	6,356	SY	$30.00	$190,667
	Earthwork/Channel Excavation	7,896	CY	$3.50	$27,637
	Land Acquisition Cost	1.7	ACRE	$30,000.00	$51,928
	Sub-Total	2,600	LF	$103.94	**$270,232**
4	**Retention Basin at Cowden Park**	**19**	**AC-FT**		
	Earthwork/Excavation	30,653	CY	$3.00	$91,960
	landscape and Irrigation	6.0	AC	$11,600.00	$69,600
	Land Acquisition Cost (City Owned)	6.0	AC	$0.00	$0
	Sub-Total				**$161,560**
5	**Retention Basin at 99th Ave and SPRR**	**35**	**AC-FT**		
	Earthwork/Excavation	56,467	CY	$3.00	$169,400
	landscape and Irrigation	4.0	AC	$11,600.00	$46,400
	Land Acquisition Cost	4.0	AC	$30,000.00	$120,000
	Sub-Total				**$335,800**
6	**Retention Basin at 107th Ave and SPRR**	**38**	**AC-FT**		
	Earthwork/Excavation	61,307	CY	$3.00	$183,920

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Project:	**Tolleson SPRR and Van Buren Street at 91st Avenue CAR**				
	Alternative 2-B: Conceptual Cost Estimate			Project No. FCD 98-23	
ID #	**Item/Description**	**Quantity**	**Units**	**Unit Cost**	**Amount**
	landscape and Irrigation	4.0	AC	$11,600.00	$46,400
	Land Acquisition Cost	4.0	AC	$30,000.00	$120,000
	Sub-Total				**$350,320**
7	**Retention Basin at 115th Ave and SPRR**	**43**	**AC-FT**		
	Earthwork/Excavation	69,373	CY	$3.00	$208,120
	landscape and Irrigation	4.5	AC	$3,000.00	$13,500
	Land Acquisition Cost	4.5	AC	$30,000.00	$135,000
	Sub-Total				**$356,620**
	Sub-Total: Tolleson Drainage Improvement Alternative 2-B				**$5,552,349**
	Engineering and Contingencies	25%			$1,388,087
	Total: Tolleson Drainage Improvement Alternative 2-B				**$6,940,436**

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Project: **Tolleson SPRR and Van Buren Street at 91st Avenue CAR**
Alternative 2-C: Conceptual Cost Estimate Project No. FCD 98-23

ID #	Item/Description	Quantity	Units	Unit Cost	Amount
1	**Channel along SPRR**	**19,800**	**LF**		
	Soil Cement Channel Lining - Trap Channel BW=24', TW=34', 1:1(H:V), D=5', (including 1' free board)	105,600	CY	$12.00	$1,267,200
	Earthwork/Channel Excavation	211,933	CY	$3.50	$741,767
	Concrete Box Culvert: 3-10'x4'x85 @ 91st Ave	255	CY	$350.00	$89,250
	Concrete Box Culvert: 4-10'x4'x85 @ 99th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x85 @ 107th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x85 @ 115th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x60 @ 95th Ave	240	CY	$350.00	$84,000
	Concrete Box Culvert: 4-10'x4'x60 @ Marshall Ave	240	CY	$350.00	$84,000
	Safety Rail	19,800	LF	$12.00	$237,600
	Land Acquisition Cost	30	ACRE	$30,000.00	$900,000
	Sub-Total	19,800	LF	$189.94	**$3,760,817**
2	**Storm Drain in Van Buren Street**	**1,600**	**LF**		
	42" RGRCP	1,600	LF	$150.00	$240,000
	Sub-Total				**$240,000**
3	**Channel along 91st Avenue**	**2,600**	**LF**		
	Concrete Channel Lining - Trap Channel BW=12', TW=19', 1:1(H:V), D=3.5', (including 1' free board)	6,356	SY	$30.00	$190,667
	Earthwork/Channel Excavation	7,896	CY	$3.50	$27,637
	Land Acquisition Cost	1.7	ACRE	$30,000.00	$51,928
	Sub-Total	2,600	LF	$103.94	**$270,232**
4	**Retention Basin at Cowden Park**	**19**	**AC-FT**		
	Earthwork/Excavation	30,653	CY	$3.00	$91,960
	landscape and Irrigation	6.0	AC	$11,600.00	$69,600
	Land Acquisition Cost (City Owned)	6.0	AC	$0.00	$0
	Sub-Total				**$161,560**
5	**Retention Basin at 99th Ave and SPRR**	**55**	**AC-FT**		
	Earthwork/Excavation	88,733	CY	$3.00	$266,200
	landscape and Irrigation	5.5	AC	$11,600.00	$63,800
	Land Acquisition Cost	5.5	AC	$30,000.00	$165,000
	Sub-Total				**$495,000**
6	**Retention Basin at 107th Ave and SPRR**	**73**	**AC-FT**		
	Earthwork/Excavation	117,773	CY	$3.00	$353,320

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Project:	Tolleson SPRR and Van Buren Street at 91st Avenue CAR Alternative 2-C: Conceptual Cost Estimate				Project No. FCD 98-23
ID #	**Item/Description**	**Quantity**	**Units**	**Unit Cost**	**Amount**
	landscape and Irrigation	6.5	AC	$11,600.00	$75,400
	Land Acquisition Cost	6.5	AC	$30,000.00	$195,000
	Sub-Total				**$623,720**
7	**Retention Basin at 115th Ave and SPRR**	**52**	**AC-FT**		
	Earthwork/Excavation	83,893	CY	$3.00	$251,680
	landscape and Irrigation	5.4	AC	$3,000.00	$16,200
	Land Acquisition Cost	5.4	AC	$30,000.00	$162,000
	Sub-Total				**$429,880**
	Sub-Total: Tolleson Drainage Improvement Alternative 2-C				**$5,981,209**
	Engineering and Contingencies	25%			$1,495,302
	Total: Tolleson Drainage Improvement Alternative 2-C				**$7,476,511**

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Project: Tolleson SPRR and Van Buren Street at 91st Avenue CAR
Alternative 2-D: Conceptual Cost Estimate

Project No. FCD 98-23

ID #	Item/Description	Quantity	Units	Unit Cost	Amount
1	**Channel along SPRR**	**19,800**	**LF**		
	Soil Cement Channel Lining - Trap Channel BW=30', TW=40', 1:1(H:V), D=5', (including 1' free board)	105,600	CY	$12.00	$1,267,200
	Earthwork/Channel Excavation	233,933	CY	$3.50	$818,767
	Concrete Box Culvert: 3-10'x4'x85 @ 91st Ave	255	CY	$350.00	$89,250
	Concrete Box Culvert: 4-10'x4'x85 @ 99th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x85 @ 107th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x85 @ 115th Ave	340	CY	$350.00	$119,000
	Concrete Box Culvert: 4-10'x4'x60 @ 95th Ave	240	CY	$350.00	$84,000
	Concrete Box Culvert: 4-10'x4'x60 @ Marshall Ave	240	CY	$350.00	$84,000
	Safety Rail	19,800	LF	$12.00	$237,600
	Land Acquisition Cost	30	ACRE	$30,000.00	$900,000
	Sub-Total	19,800	LF	$193.83	**$3,837,817**
2	**Storm Drain in Van Buren Street**	**1,600**	**LF**		
	42" RGRCP	1,600	LF	$150.00	$240,000
	Sub-Total				**$240,000**
3	**Channel along 91st Avenue**	**2,600**	**LF**		
	Concrete Channel Lining - Trap Channel BW=12', TW=19', 1:1(H:V), D=3.5', (including 1' free board)	6,356	SY	$30.00	$190,667
	Earthwork/Channel Excavation	7,896	CY	$3.50	$27,637
	Land Acquisition Cost	1.7	ACRE	$30,000.00	$51,928
	Sub-Total	2,600	LF	$103.94	**$270,232**
4	**Retention Basin at Cowden Park**	**19**	**AC-FT**		
	Earthwork/Excavation	30,653	CY	$3.00	$91,960
	landscape and Irrigation	6.0	AC	$11,600.00	$69,600
	Land Acquisition Cost (City Owned)	6.0	AC	$0.00	$0
	Sub-Total				**$161,560**
5	**Retention Basin at Park Site at 86th Ave and Van Buren**	**46**	**AC-FT**		
	Earthwork/Excavation	74,213	CY	$3.00	$222,640
	landscape and Irrigation	7.0	AC	$11,600.00	$81,200
	Land Acquisition Cost (City Owned)	7.0	AC	$0.00	$0
	Sub-Total				**$303,840**
6	**Retention Basin at 99th Ave and SPRR**	**14**	**AC-FT**		
	Earthwork/Excavation	22,587	CY	$3.00	$67,760

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Project:	Tolleson SPRR and Van Buren Street at 91st Avenue CAR Alternative 2-D: Conceptual Cost Estimate			Project No. FCD 98-23	
ID #	**Item/Description**	**Quantity**	**Units**	**Unit Cost**	**Amount**
	landscape and Irrigation	3.0	AC	$11,600.00	$34,800
	Land Acquisition Cost	3.0	AC	$30,000.00	$90,000
	Sub-Total				**$192,560**
7	**Retention Basin at 107th Ave and SPRR**	**33**	**AC-FT**		
	Earthwork/Excavation	53,240	CY	$3.00	$159,720
	landscape and Irrigation	3.8	AC	$11,600.00	$44,080
	Land Acquisition Cost	3.8	AC	$30,000.00	$114,000
	Sub-Total				**$317,800**
8	**Retention Basin at 115th Ave and SPRR**	**41**	**AC-FT**		
	Earthwork/Excavation	66,147	CY	$3.00	$198,440
	landscape and Irrigation	4.3	AC	$3,000.00	$12,900
	Land Acquisition Cost	4.3	AC	$30,000.00	$129,000
	Sub-Total				**$340,340**
	Sub-Total: Tolleson Drainage Improvement Alternative 2-D				**$5,360,309**
	Engineering and Contingencies	25%			$1,340,077
	Total: Tolleson Drainage Improvement Alternative 2-D				**$6,700,386**

APPENDIX D

Scope of Work

EXHIBIT "A"
CONTRACT FCD 98 – 23

CANDIDATE ASSESSMENT REPORT
Tolleson – SPRR and Van Buren Street at 91st. Avenue
Drainage Improvement Project
PCN # 565 – 01 - 01

Scope of Work

1.0 PROJECT DESCRIPTION

1.0.1 General Work Description

This Candidate Assessment Report(s) (CAR) will be used to verify existing information on a specific project need, develop additional information for the evaluation of a proposed project, develop proposed alternatives and options, and identify estimated costs and schedules suitable for determining programming the Capital Improvement Program (CIP) project.

The report will provide a complete background, which will include the identification of previous storm events causing flooding inTolleson, within SPRR and Van Buren Street at 91st. Avenue.

Roads affected by the drainage are 91st. Avenue from I-10 to the SPRR, one-half mile east and west of 91st. Avenue along Van Buren Street, and east and west of 91st Avenue along the SPRR.

The report will review existing data from the "Floodplain Delineation of the Tolleson Area", Project FCD 95-26, Hydrology report, prepared for the Flood Control District of Maricopa County by Dibble & Associates Consulting Engineers, December 9, 1998 and the "Floodplain Delineation of the Tolleson Area (DRAFT) Final Report and Technical Data Notebook, prepared for the Flood Control District of Maricopa County FCD Contract #95 – 26, December 8, 1998 by Dibble & Associates and applicable topographic photos from the Maryvale ADMS.

Rights-of-way will be identified in the report examining agency responsibilities for acquisition and maintenance.

The report is to provide the identification of drainage improvements, minimize erosion, and protect future development along the SPRR and Van Buren Street at 91st. Avenue, and review of existing development and residential properties.

The study will identify nuisance drainage, vegetation, wildlife habitat, water quality, equestrian and bicycle trails, and reduction of street drainage.

The report will identify concepts for the mitigation and its feasibility of basin structures, open space concepts, channelizaton recommendations, 404 and 401 implications, residential and commercial relocation cost, and verify benefits served to the community, quality of life, recreational uses, groundwater enhancements, environmental quality and flood protection.

The report will guide the funding requirements and verify the estimates of the City of Tolleson and financial responsibilities of each jurisdiction involved.

The report will provide several alternative scenarios including a preferred alternative including basins, cost benefits, benefited areas, and open space amenities for recreation and wildlife.

1.0.2 Background and Project Overview:

The City of Tolleson originated the project request in a proposal for inclusion into the Capital Improvement Project Prioritization process of the Flood Control District of Maricopa County, with a project title of "Van Buren Street Drainage" and "Southern Pacific Railroad Tracks Drainage Improvements" both as separate projects.

For purposes of this (CAR), Candidate Assessment Report, the title will incorporate the two projects into one and address the drainage problems and flood protection project recommendations as one project. The project was submitted on several occasions from October 6, 1994 to the present. The original proposal submitted did not contain sufficient information to effectually consider the project for the Capital Improvement Program.

(1) The City of Tolleson's goal was to eliminate the FEMA designated 100 year floodplain and (2) substantial local flooding along 91st Avenus. Their intent was to provide flood protection basically for the benefit of the urbanized area, identified on the current FIRM maps, along the SPRR which runs through the City of Tolleson. The estimated area to be protected is 120 acres, of which 100 acres are developed and 20 acres undeveloped.

The total area is within the jurisdiction of the City of Tolleson. The roadway along 91st. Avenue to the north is within the Maricopa County Department of Transportation responsibility for approximately one-quarter of a mile.

The City identified the benefited communities as an area containing residential dwelling, mobile homes, industrial and commercial buildings, railroad property, water production facility, roadway property, and approximately two and one-half miles of residential streets.

Project funding was determined by the City without pre-design concepts somewhere in the range of $1 to $2 million dollars not including environmental permitting or mitigation. The City of Tolleson stated they did not have funding available to support the project but provide funding for the operation and maintenance of the facilities that are constructed.

District participation would normally be estimated at 50% of the estimated project cost. No cost estimates were indicated for land transaction, aesthetic costs, or permits for 404 or 401 of the Clean Water Act.

1.2 Purpose: The purpose of the CAR will basically be to review and analyze existing information, and where necessary compile and develop project data. Data compiled for this project is intended to serve as a planning tool and decision making tool for the evaluation of several alternatives and also for the feasibility of this project as submitted by the City of Tolleson for possible inclusion into the Capital Improvement Program (CIP) program.

1.3 Scope of Work and Work Assignment: A scope of work will be assigned (work assignment) to the Consultant that describes the general project tasks, needs, and where known any work effort details. The Consultant will be responsible to furnish the District with a definitive scope appropriate to the needs of the general work assignment given for the project for review and approval of the District prior to the notice to proceed.

1.4 Scoping Outline: The Consultant will provide in the CAR report, a scoping outline, which is a brief written CAR narrative describing the findings of the assessment not to exceed three pages. The scoping outline will identify findings associated with list of tasks and general information, and will serve as an executive summary of the CAR work assignment. The Scoping Outline will include the following:

Project requested by:
Recommended Project: Title/Name and Date Presented
Problem Identification and Background:
Major Features & Any limitations:
Estimated Initial Cost:
Alternatives:
- **No cost - other contributions, etc.**
- **Low cost - Soft/Hard $**
- **Full cost - Soft/Hard $**

Value Engineering Recommendations:
Future Land Uses/Present Uses:
Listing of Probable Partners
Preferred Alternative & Brief Discussion of Other Alternative(s):
Brief Recommendation:
Attachments: Maps, Drawings, City Limit Maps, Letters, etc.:

1.5 Tasks: Work Assignment: The Consultant will complete the following tasks for the CAR work assignment:

1.5.1 Project (CAR) Name/Title: Tolleson – SPRR and Van Buren Street at 91st. Avenue PCN #565 – 01 –01. The Consultant will review the request made by the City of Tolleson, City Manager, 9555 West Van Buren Street, Tolleson, Az., 85353. Phone: 936 – 7111 {fax - (602) 994-7117} Contact: Manuel O. Dominguez.

1.5.2 General Description: The Consultant shall provide a description of the following items in the CAR report.

1.5.2.1 The Consultant will describe the SPRR and Van Buren Street at 91st. Street corridor and drainage area.

1.5.2.2 The Consultant will describe structures, channels or existing facilities within the corridor or adjacent to the corridor that has significant interest in the project.

1.5.2.3 The Consultant will describe the effects of existing drainage features and development within the project area.

1.5.3 Location of the Project (CAR) Area: The Consultant shall describe the proposed CAR area with reference to adjoining District facilities, public or private facilities, development, structures, public and private lands, municipalities, recreation areas, major transportation corridors, major transportation generators, and similar features which characterize the CAR.

1.5.3.1 The Consultant will describe limits of the project area location using a general legal description, which would include the Township, Range and Section of the project. A Site Map may be provided [if available] by the District, County, or Agency jointly cooperating in

the project but will not serve to be the final product in describing the limits of the project or other surrounding areas of influence. The District will provide all available county, town, or city limits drawings or FEMA mapping for the project study area.

1.5.4 Project Information. The Consultant will provide the following information within the specific project area, and maintenance areas.

1.5.4.1 The Consultant will describe existing drainage structures of developers and agencies applicable to the project. Photos of structures and if available, damages and history of flood events will be provided to the District in the report.

1.5.4.2 The Consultant will review the project area regarding on-and off-site flows and level of protection provided by each development and anticipated maintenance.

1.5.4.3 The Consultant will review and identify existing and future development.

1.5.4.4 The Consultant will contact the City of Tolleson, and other applicable agencies for review of available hydrologic and hydraulic information in support of this assessment and provide a list to the District of what information has been reviewed and retained as part of this project.

1.5.4.5 The Consultant will identify drainage complaints and roadway flooding problems within the project area and will identify property and agencies affected by the flooding problems.

1.5.4.6 The Consultant will prepare conceptual design recommendations and cost overview for two design approaches that would include: Hard Channel Lining Design, Culverts, and Soft/Environmentally Sensitive Channel Lining, for each alternative, including the preferred alternative.

1.5.4.7 The Consultant will identify the benefited areas for the recommended approach.

1.5.4.8 The Consultant will review and identify all other associated studies related to the (CAR) project.

1.5.4.9 The Consultant will identify District vs. City of Tolleson land ownership's within the project area and identify maintenance responsibilities within rights-of-way.

1.5.4.10 The Consultant will identify and research utility locations and utility corridors, evaluate relocation costs, and use GIS data from the City and the District, where available.

1.5.4.11 The Consultant will review available Arizona Department of Transportation drawings regarding the Interstate 10 and corridor drainage information and basins where applicable.

1.5.4.12 The Consultant will research structure ownership or facility ownership.

1.5.4.13 The Consultant will review bordering development plans, recreational sites, and other amenities where applicable.

1.5.4.14 The Consultant will record and contact the City ofTolleson, Maricopa County Department of Transportation, and Arizona Department of Transportation for traffic incidents and complaints.

1.5.4.15 The Consultant will use the District GIS data and other available GIS data for the CAR, to be provided by the District and the City of Tolleson, where available.

1.5.4.16 The District will provide recent bid tabs.

1.5.4.17 The Consultant will conduct site visits to take photographs to document existing conditions and to aid in the completion of other tasks.

1.5.5 Reason for Improvement: The Consultant shall describe the general reasons for the CAR improvement and include recommendations for opportunity in recreational enhancements, ground water recharge, water quality, and those that may benefit the surrounding communities.

1.5.6 Drainage Information: The Consultant shall briefly identify and summarize the 100-year peak flows for channels or structures and/or other affected areas within the project area, based on available reports and studies. The District will provide the HEC 1 model for the study area (if available).

1.5.7 Environmental: The Consultant shall document any visually apparent environmental site conditions that will need to be evaluated for study.

1.5.8 Photography and Presentation Material: The Consultant will furnish the District (Power Point) presentation material for the CAR. Material may include available mapping and aerial photography. The Consultant will prepare and make a presentation that will identify the Recommended Alternative. Calculations are not expected nor is detailed design level accuracy expected, however, planning study information produced by the Consultant will be provided to the District for cost estimating and fiscal planning.

1.5.9 Feasibility of the Project: The Consultant will examine the feasibility of other study recommendations that may be included as part of the viable alternative recommended.

1.5.10 Joint Project Potential Activities: Where appropriate, the Consultant will identify potential participating agencies with the District.

1.5.11 Land Use: The Consultant will prepare a description of the existing land use identifying the approximate percentage of affected land in the area bordering the project. This may include areas adjacent to commercial development, major roads, active farming, residential, and other uses. Larger enterprises affected by this project shall be identified by name and described.

1.5.12 Rights-of-way: Other than property previously identified by the District, any additional rights-of-way identified as required acquisition for the project shall be provided to the District by the Consultant. Descriptions of rights-of-way will include the identity of the owners, the delineated property, and the estimated acreage. The District will make available property ownership information where available.

1.5.13 Alternatives: Two alternatives will be prepared by the Consultant for the proposed CAR in addition to the "No Action" Alternative. Within each alternative, one or two options may be proposed for smaller improvement features such as alternative retention basin locations, structures, or other items as may be recommended.

1.5.13.1 "No Action" Alternative: This alternative is simply defined as a no-further action alternative.

1.5.13.2 "Low Cost" Alternative: This alternative shall include added improvements and new structures and combinations of both. Drainage review may be handled in a more temporary manner. For example, detention basins may be provided in lieu of storm drains. Justification must be written to include several phased installation periods.

1.5.13.3 Full Cost Alternative: The Full Improvement Alternative shall list all items planned to be part of the CAR. The full improvement shall include all additional items such as generic land values, real estate relocation costs and severance costs, further potential environmental evaluation, further archeological review, and important estimated costs.

1.5.13.4 Preferred Alternative: The Consultant will identify a Preferred Alternative statement in the opening section of the final CAR report. The alternative statement shall indicate the potential jurisdictions, agencies or other parties that may be involved.

1.5.14 Evaluation Criteria: The Consultant shall select the preferred alternative from the following criteria. The criteria is not limited to the list below, but as a minimum, shall contain the following:

Potential Benefits to the Citizens
Project Feasibility and Benefited Area
Capital Improvement Costs
Scheduling
Environmental Concerns
Estimated Maintenance (short and long range)
Public Involvement Needs
Inter-agency Involvement
Flood Protection Level
Budget Evaluation
Floodprone Area(s) Eliminated

1.5.15 Preliminary Design Focus Effort: The Consultant will furnish a preliminary design estimate of Labor Hours and Direct Costs required for a professional services provider to prepare a future Design Concept Report (DCR). The District understands that this report is an estimate only but would like the Consultant to indicate whether or not a DCR is necessary for the next project effort.

1.5.16 Cost Analysis: The Consultant shall prepare an outline of estimated costs extended throughout the CAR for each alternative.

1.5.17 Report Outline: The Consultant will submit a proposed report outline.

1.5.18 Report Format: The recommended report format shall be on 8½-inch by 11-inch paper with report foldouts no larger than 11 inches by 17 inches. Sheets larger than 11 inches by 17 inches shall be placed in map pockets, and desirable rights-of-way maps 11inches x 36 inches shall be placed in appropriately sized map pockets.

1.5.19 Decision Paper: The Consultant will prepare and discuss with all related agencies a decision paper for the selection of the preferred alternative plan.

1.5.20 Public Involvement: The Consultant will recommend Public Involvement requirements for the project at end of the CAR study, and report on the City of Scottsdale's existing comments of previous public input and the City recommendations (if any).

1.5.21 Electronic Media: The District requires that the Consultant prepare and submit all final reports on electronic disk in MS Word 6.0 format, readable 3.5" diskettes. All spreadsheets should be in MS Excel 5.0 format and presentation slides in MS Power Point 7.0.

1.5.22 Quality Review: All (CAR) reports shall be checked by a Professional Engineer in the state of Arizona, other than the originator and indicate such review on the report.

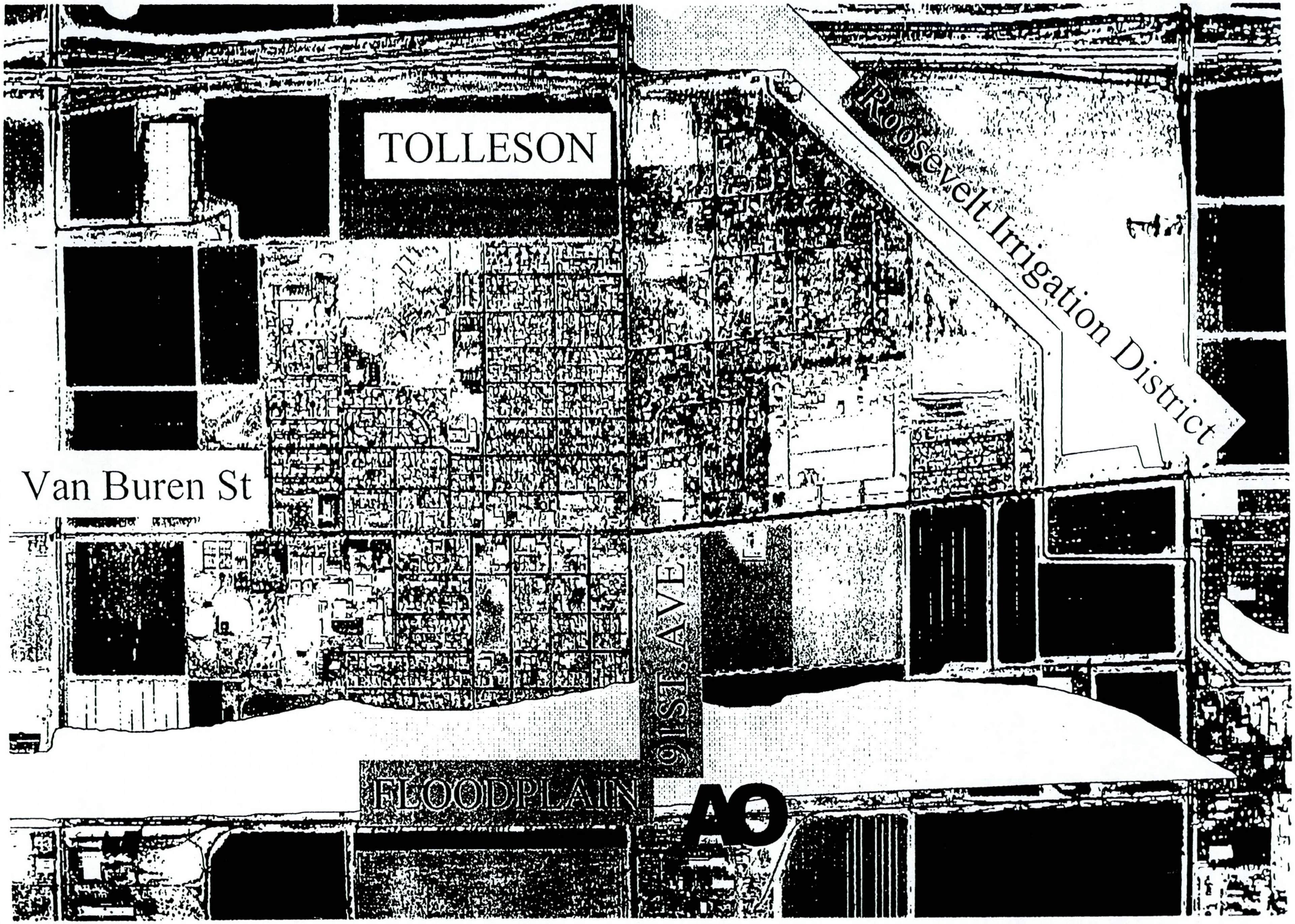
1.5.23 Deliverables: The Consultant is to provide five (5) copies of the draft CAR report for District review. The Consultant will incorporate review comments into a final report and provide eight (8) copies to the District. The report shall show the findings for this scope of work. All data collected under this scope of work shall be listed and made available upon submitting the CAR to the District relevant to this project.

1.5.24 Preparation Time: The Consultant will anticipate the CAR report data preparation time to evaluate the CAR project in 4 weeks.

1.5.25 Alternative Review: The Consultant will review and analyze all the alternatives with the District within 2 weeks of the project alternative selection.

1.5.26 Draft Submittal: The Consultant will submit a draft CAR Report for the SPRR and Van Buren Street at 91st. Avenue Candidate Assessment Report within 2 to 4 weeks after the alternative review.

1.5.27 Final Submittal: The Consultant will submit the final CAR Report for the SPRR and Van Buren Street at 91st. Avenue Candidate Assessment Report within two weeks following the draft report submittal.


TOLLESON
Roosevelt Irrigation District
Van Buren St
91ST. AVE.
FLOODPLAIN
AO

APPENDIX E

Excerpts from Selected Reports

APPENDIX E-1: Proposal of City of Tolleson Southern Pacific Railroad Tracks Drainage Improvements

City of Tolleson
Proposal for
Flood Control District of Maricopa County
CIP Project for Fiscal Year 95/96
October 7, 1994

Project Name:
Southern Pacific Railroad Tracks Drainage Improvements - A pre-design study is needed to determine the best method by which to eliminate the floodplain and ponding located adjacent to and caused by the railroad tracks which run through Tolleson. Because the area is so flat, the floodplain extends nearly 1/4 mile north from the tracks. The area that requires protection at this time is the heavily developed area located between 99th and 91st Avenues.

Developed Area Protected:
The project area is located immediately north (upstream) of the Southern Pacific Railroad tracks which are elevated above the surrounding terrain by several feet as they extend east-west through the center of Tolleson. The elevation of the tracks causes a 100-year floodplain to exist which has been identified on the current FIRM maps. The floodplain also extends completely through the center of the City.

The area most affected by the lack of drainage immediately upstream of the railroad tracks is the residential and commercial area located between 91st Avenue and 95th Avenue. This area has been in existence since before the City was incorporated in 1929 and suffers on a regular basis due to the lack of drainage through the railroad embankment. The northernmost extent of the affected area would essentially match the floodplain limits as shown on the FIRM map.

It is estimated that 100 residential dwellings, 30 mobile homes, and 12 industrial or commercial buildings would be protected by drainage improvements in the area. Included in the area is one of the City's principal water production facilities, which would also receive increased protection from flooding.

It is further estimated that approximately two miles of streets would be protected from deterioration due to regular flooding. Adding significance to this protection is the fact that the City is currently in the middle of a four-year program to reconstruct its residential streets, many of which are located in this proposed project area.

The total area that would receive increased flood protection from this project is 120 acres. It is important to note that many of the residents living in the project area have low to moderate income levels.

Hydrologic/Hydraulic Significance:
The project area is located at the downstream end of an almost flat watershed which slopes from the Interstate 10 right-of-way to the south approximately 1.25 miles to the location of the railroad tracks. The construction of I-10 in the 1980's isolated this portion of the watershed from the effects of any runoff from the area north of I-10. However, the extent to which the floodplain at the tracks has been affected by that construction has not yet been determined. The intervening watershed contributes runoff which collects upstream of the tracks and causes serious drainage problems in the project area.

Since a drainage study has not been conducted to quantify the amount of runoff, especially since the I-10 construction, the first element of this project is an analysis to determine the exact watershed conditions and amount of runoff, the areas directly affected, and the method by which the runoff can be dissipated.

The existing floodplain upstream of the tracks is primarily one of ponding rather than riverine. However, the floodplain does drain to the west along the north side of the tracks. This downstream method of conveyance, therefore, strictly speaking, does exist, but it does not completely drain the area in question, thus leaving behind local ponds that must dissipate through evaporation or percolation. This relatively slow method of dissipation no doubt leads to vector problems associated with stagnant water.

Total Area Protected:
Based on the FIRM map, the total area to be protected by this project through removal from the 100-year floodplain is 120 acres. Of that total, 100 acres are currently developed and 20 acres are undeveloped or vacant land. None of the undeveloped or vacant land is platted. All of this area lies within the jurisdiction of the City of Tolleson. There do not appear to be any environmentally sensitive lands lying within the area to be protected by implementation of this project.

Master Plan Element:
The City of Tolleson currently does not have an adopted drainage master plan. However, the City utilizes drainage criteria for new development that requires on-site retention of the 100-year, 6-hour duration storm event, thus preventing new development from contributing to existing drainage problems within the City.

The City has earlier this year requested that the Flood Control District accelerate its schedule for the Area Drainage Master Study that has been planned for the Tolleson area. When that study is complete, it is very likely that this project will be one of those recommended for implementation as a part of the ADMP.

Level of Protection:
The level of protection for the area benefited by this project will essentially include the area currently lying within the 100-year floodplain as shown on the

FIRM map. Therefore, if the implemented solution for this project allows the virtual elimination of the 100-year floodplain, then that is the level of protection that will be afforded. Secondary levels of protection will also be realized if, in solving this problem, better conveyance of runoff that reaches the floodplain area is developed. In this way, many of the homes with lots lying close to or below the elevations of adjacent streets will benefit from protection since, even though they are not located within the floodplain, they will not be a part of the conveyance system for runoff to reach the floodplain in the future.

Environmental Quality/Areawide Benefits:
In assessing the environmental benefits, it is assumed that the solution to this problem is to convey the runoff that reaches this area to the west in a surface conveyance along the north side of the railroad tracks. If so, then the water that once ponded upstream of the tracks would then move to the west and south where it will eventually find its way into the Salt/Gila River. Vegetation and wildlife habitat along the way would benefit from the additional runoff that would help to support riparian habitat. Recreational uses that would normally be associated with riparian areas would also benefit.

Groundwater enhancement, if defined as recharge, would not be an issue in this case, since the groundwater in the Tolleson area is already plentiful, with normal depths to groundwater being on the order of 100 feet. However, groundwater quality could benefit from this project. Much of the runoff that reaches the project area comes from streets and other paved surfaces. This runoff is relatively high in hydrocarbon and heavy metal contamination. If the runoff is not allowed to percolate into the groundwater table, but is encouraged to move through a downstream vegetative and riparian area, then these contaminants would be largely prevented from reaching the groundwater table and would be diluted and treated in downstream reaches such as the Salt/Gila River.

The environmental impact due to the construction of this project would depend on the nature of the project to be implemented. However, a surface conveyance such as a shallow channel would not create much of an environmental impact, especially since the area along its potential route has been either adjacent to railroad track right-of-way or under cultivation for over 100 years.

Total Project Cost:
Pre-design studies have not yet been completed to provide a concept for the project. Therefore, it is difficult to estimate the project cost. However, should a combination of shallow channels and culverts be required as the solution, that project could cost in the range of $1 million to $2 million.

The costs associated with environmental permitting or mitigation should be relatively small, since the potential solution would be simple to construct and would be located within areas that have already been developed or cleared in some way. The aesthetic and public acceptance costs would likewise be small, again since the project is located in an area that is primarily commercial and industrial and those residents who live within the project area would welcome a solution to their drainage problems.

Operation & Maintenance Costs:
Operation and maintenance costs would tend to be small for this project since the likely solution will involve a shallow channel with some culverts for conveyance under streets. Furthermore, the runoff is not expected to be a large amount nor flowing at high velocities. Therefore, maintenance following storm events should not be significant.

The City of Tolleson would be responsible for the operation and maintenance of this project once constructed.

Agency Priority:
A solution to this drainage problem has been a high priority with the City for a long time. Recently, City staff has considered the problem and, realizing that the potential solution involved adjacent jurisdictions as well as FEMA, the railroad and unincorporated areas of the County, felt that the project would best be studied and implemented by the Flood Control District.

Level of Local Participation:
While the City of Tolleson does not have funds currently available to help support this project, the City can contribute in-kind with staff support where possible and future operation and maintenance of facilities that are constructed.

Furthermore, the City of Tolleson is growing rapidly especially with large commercial and industrial projects that will significantly increase the City's and County's assessed valuation during the next several years. Finally, the Flood Control District apparently has not expended any significant funds on projects within the City of Tolleson.

APPENDIX E-2: Proposal of City of Tolleson

Van Buren Street Drainage Improvements

City of Tolleson
Proposal for
Flood Control District of Maricopa County
CIP Project for Fiscal Year 95/96
October 7, 1994

Project Name:
Van Buren Street Drainage - A pre-design study is needed to determine the best method by which to eliminate ponding of runoff within two street intersections in the central part of the City.

Developed Area Protected:
The goal of this project is to remove runoff that accumulates in the intersections of 95th and 96th Avenues with Van Buren Street, which is caused by an inadequate slope to the west on the north side of Van Buren Street. From the standpoint that the ponding in the intersections is a traffic safety hazard, the developed area to be protected by this project would essentially include all of the central portion of Tolleson, an area of 600 acres.

The pedestrians who need to cross the streets at these intersections during periods of large amounts of ponding are forced to cross outside of the established crosswalks, thus placing themselves in danger with the adjacent traffic. Furthermore, there are two school campuses located within one-half mile of these intersections (one is located immediately across the street). Thus, many of the school children utilize the sidewalks and crosswalks at these two intersections at least 2 or 3 times each day.

Van Buren Street is the main street through the center of the City. The ponding at these intersections will ultimately cause the deterioration of the pavement due to saturation of the base, thus shortening the life of that portion of the street.

Hydrologic/Hydraulic Significance:
The watershed which contributes to the ponding at these intersections begins at I-10 on the north and slopes very little to the south and west through the older residential portion of the City on the north side of Van Buren Street. The contributing watershed is approximately 300 acres in size. Apparently, a drainage analysis has not been conducted to quantify the watershed conditions nor to determine the amount of runoff that reaches these intersections. The crown of Van Buren Street prevents the runoff from crossing the street and continuing to flow to the south. Therefore, the only way for the water to drain is in the north gutter line of Van Buren Street to the west past an undeveloped frontage and within Maricopa County right-of-way. Since that route is essentially uphill from these intersections, the water ponds to a depth of one to two feet before any additional runoff can flow to the west.

Total Area Protected:
The area receiving direct protection through the implementation of this project consists of the intersections and the adjacent commercial parcels including their parking lots which are sometimes inundated. In a larger sense, any pedestrian or driver who must use these intersections during periods of ponding would be protected by this project.

Master Plan Element:
The City of Tolleson currently does not have an adopted drainage master plan. However, the City utilizes drainage criteria for new development that requires on-site retention of the 100-year, 6-hour duration storm event, thus preventing new development from contributing to existing drainage problems within the City.

The City has earlier this year requested that the Flood Control District accelerate its schedule for the Area Drainage Master Study that has been planned for the Tolleson area. When that study is complete, it is very likely that this project will be one of those recommended for implementation as a part of the ADMP.

Level of Protection:
By providing positive and complete drainage of these two intersections, the level of protection to the adjacent properties and pedestrians could be in excess of the 100-year storm event.

Environmental Quality/Areawide Benefits:
Groundwater quality would be enhanced through this project since the runoff, which contains a certain amount of hydrocarbons and heavy metals from paved areas, would be moved quickly out of the area rather than be allowed to pond and accumulate additional contamination. Since these ponded areas drain through percolation, some of that contamination may be finding its way into the relatively shallow groundwater.

If the solution is to convey the runoff under Van Buren Street to the City-owned Cowden Park to the south where it could be retained, then the beneficial filtration afforded by the turf could mitigate the amount of contamination that might reach the groundwater.

Vegetation within the park would benefit due to the additional source of water that would be available during times of runoff. Also, during the times when the runoff is being retained within the park, wildlife would benefit from the pond which is easier for them to access compared to a street intersection.

The environmental impact due to the construction of this project would be minimal since the construction would occur within developed areas and primarily within street rights-of-way.

Total Project Cost:
Pre-design studies have not yet been completed to provide a concept for the project. Therefore, it is difficult to estimate the project cost. A likely solution would be to construct catch basins in the intersections, tie them together with underground pipe storm drains and extend a buried pipe storm drain to the south to daylight in Cowden Park. A project of that scope would probably cost less than $1 million.

The costs associated with environmental permitting or mitigation should be relatively small, since the potential solution would be simple to construct and would be located within areas that have already been developed or cleared in some way. The aesthetic and public acceptance costs would likewise be small, again since the project is located in an area that includes primarily commercial, residential and school uses. Those residents who live adjacent to the project area and the users of the facilities in the area would welcome a solution to these drainage problems.

Operation & Maintenance Costs:
Operation and maintenance costs would tend to be small for this project since the likely solution will involve a simple catch basin, storm drain and retention basin concept. Furthermore, the runoff is not expected to be a large amount nor flowing at high velocities. Therefore, maintenance following storm events should not be significant.

The City of Tolleson would be responsible for the operation and maintenance of this project once constructed.

Agency Priority:
A solution to this drainage problem has been a high priority with the City for a long time. Recently, City staff has considered the problem and, realizing that the condition results from inadequate drainage along County right-of-way, felt that the project would best be studied and implemented by the Flood Control District and, earlier this year, requested the Flood Control District to accelerate the ADMS for this area to help identify solutions to problems such as this.

Level of Local Participation:
While the City of Tolleson does not have funds currently available to help support this project, the City can contribute in-kind with staff support where possible and future operation and maintenance of facilities that are constructed.

Furthermore, the City of Tolleson is growing rapidly especially with large commercial and industrial projects that will significantly increase the City's and County's assessed valuation during the next several years. Finally, the Flood Control District apparently has not expended any significant funds on projects within the City of Tolleson.

APPENDIX E-3: Excerpts from Floodplain Delineation of the Tolleson Area – Hydrology Report

FLOODPLAIN DELINEATION OF THE TOLLESON AREA

PROJECT FCD 95-26

HYDROLOGY REPORT

Prepared for

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Registered Professional Engineer (Civil)
CERTIFICATE NO.
21684
BRIAN J.
FRY
Date Signed 5-24-99
ARIZONA, U.S.A.

Prepared by

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS
Since 1962

May 14, 1999

FLOODPLAIN DELINEATION OF THE TOLLESON AREA

HYDROLOGY REPORT

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FLOODPLAIN DELINEATION OF
THE TOLLESON AREA

HYDROLOGY REPORT

I. INTRODUCTION

A. General

This hydrology report is prepared for the Flood Control District of Maricopa County as part of the Floodplain Delineation of the Tolleson Area. The purpose of the project is to prepare hydrology and hydraulics to delineate areas of flooding due to conveyance and ponding behind the Roosevelt Irrigation District Main Canal and the Southern Pacific Railroad between 35th Avenue and El Mirage Road in the cities of Phoenix and Tolleson, Arizona. This report documents the development of project hydrology. A companion report documents the delineation of the conveyance and ponding areas.

B. Scope of Study

The project consists of approximately 15 total linear miles of floodplain delineation. Six miles of delineation are performed along the Southern Pacific Railroad (SPRR) from east of 83rd Avenue to El Mirage Road, and approximately 9 miles of delineation are performed along the Roosevelt Irrigation District (RID) Main Canal from 35th Avenue to Interstate 10. A HEC-RAS hydraulic model is developed for 2 linear miles north of the SPRR and RID Canal from 67th Avenue to 83rd Avenue and for approximately 6 miles along the north side of the SPRR from 75th Avenue to El Mirage Road. The project includes field survey work, hydraulic analysis, and the updating of 53 square miles of watershed hydrology. The Study Area is shown on **Figure 1**.

C. Previous Studies and Reports

The City of Tolleson, west of 75th Avenue was first studied in 1978 by Harris-Toups Associates as part of the *Flood Insurance Study, City of Tolleson, Maricopa County, Arizona*. Hydrology was developed for the area using Soil Conservation Service methods for the 100 year flood. Ponding limits were identified for the 100-year, 24-hour storm and flood hazard zones were identified. Interstate 10 was not constructed at the time of the study. The report indicates that at

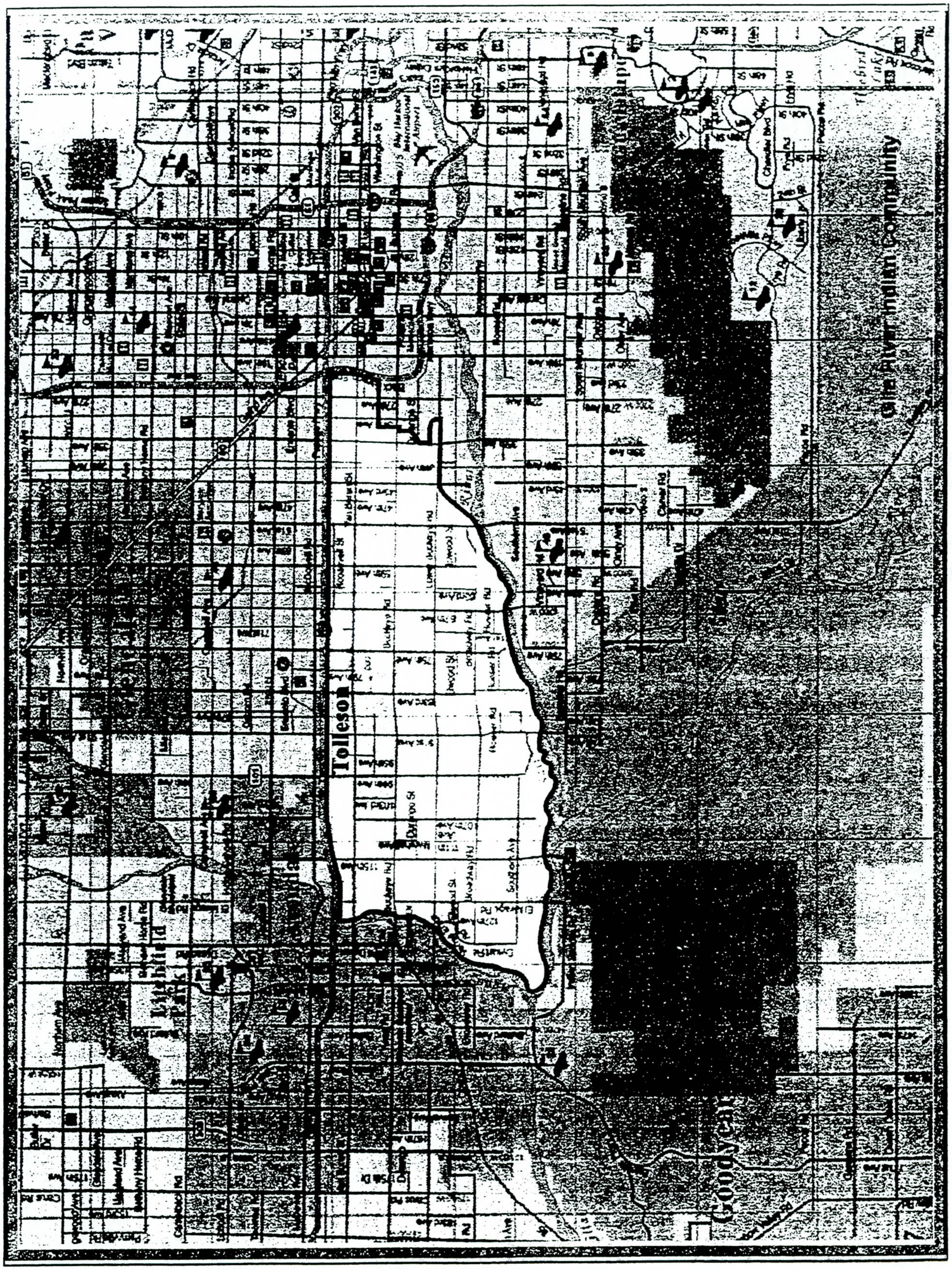

Figure 1 - Study Area

the time ADOT was delaying construction of Interstate 10. Therefore, the study did not account for the impacts of Interstate 10.

The Flood Control District of Maricopa County (FCDMC) prepared new hydrology based on methodology contained in the *Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology*. The new hydrology accounts for the flow diversions created by construction of Interstate 10. Development of the hydrology was based on USGS mapping and field reconnaissance. The FCDMC hydrology is updated as part of this study based on March 1994 detailed mapping prepared at 1"=200' scale with a 2 foot contour interval.

D. Watershed Description

The approximate watershed limits are Interstate 10 on the north, the Salt River on the south, Interstate 17 on the east and the Agua Fria River on the west. The direction of runoff is generally from the northeast to the southwest. The watershed is characterized by a large amount of agricultural land with increasing amounts of residential and industrial development taking place. As a result, overland flow is the predominant flow condition. The north watershed boundary was created by the construction of Interstate 10. The interstate intercepts runoff from the north and diverts it to the Agua Fria River.

Two features that play a significant role in defining the drainage patterns in the watershed are the Roosevelt Irrigation District Main Canal (RID Canal) and the Southern Pacific Railroad (SPRR). The RID Canal and the SPRR are elevated through the watershed. Roadways that cross both features typically rise to meet the elevated grades and proceed over the top. The elevated railroad and canal with the crossing roadways form ponding "cells." Runoff reaching the elevated canal or railroad ponds until it either overtops the railroad or canal, or until it overtops the sag portion of the crossing roadways. Overtopping flows are then directed westerly along the railroad or canal, or are directed southerly over the railroad or canal, or a combination of the two.

Other features that define the flow pattern are roads and local irrigation ditches. Low flows accumulate along roadways and ditches, converging at road intersections at the northeast corner supplemented with field investigations. The drainage subareas are shown on **Figure 2** and on the foldout **Exhibit 1** (Sub-basin Boundaries) contained in a folder at the back of the report.

C. Rainfall

Point precipitation rainfall values are taken from NOAA Atlas II, Volume VIII. The PREFRE program included with the DDMS was used in conjunction with the precipitation isopluvial maps contained in the DDM1. The 100-year twenty-four hour point precipitation value is 3.99 inches.

Point precipitation values are reduced based on contributing drainage area using depth-area reduction factors from DDM1. A table of depth-area rainfall values is input into the HEC-1 model. The HEC-1 model computes runoff hydrographs for each rainfall value provided in the table. The model then interpolates between the hydrographs to obtain the appropriate hydrograph based on the total watershed area contributing runoff to the point of interest. The SCS Type II rainfall distribution is used for the twenty-four hour duration storm. The precipitation frequency values and the PREFRE output data are contained in the **Appendix**.

D. Rainfall Losses

Rainfall losses are modeled using the Green and Ampt infiltration equation. The rainfall loss parameters are developed using guidance provided in DDM1. The Green and Ampt infiltration equation parameters are based on logarithmic area-averaging of the map unit hydraulic conductivities (XKSAT) for the mapped soils in each subbasin, and the selection of capillary suction (PSIF) and soil moisture deficit (DTHETA) based on the calculated subbasin value of XKSAT. The bare ground XKSAT values for each subbasin are then adjusted for vegetation cover. The calculation of these parameters was accomplished using the MCUHP2 module of the DDMS model.

Soil types within the watershed were determined from the SCS *Soil Survey of Maricopa County, Central Part*, September 1977. The Flood Control District of Maricopa County input the soils data into their ARC/INFO Geographic Information System (GIS) and provided the area of each

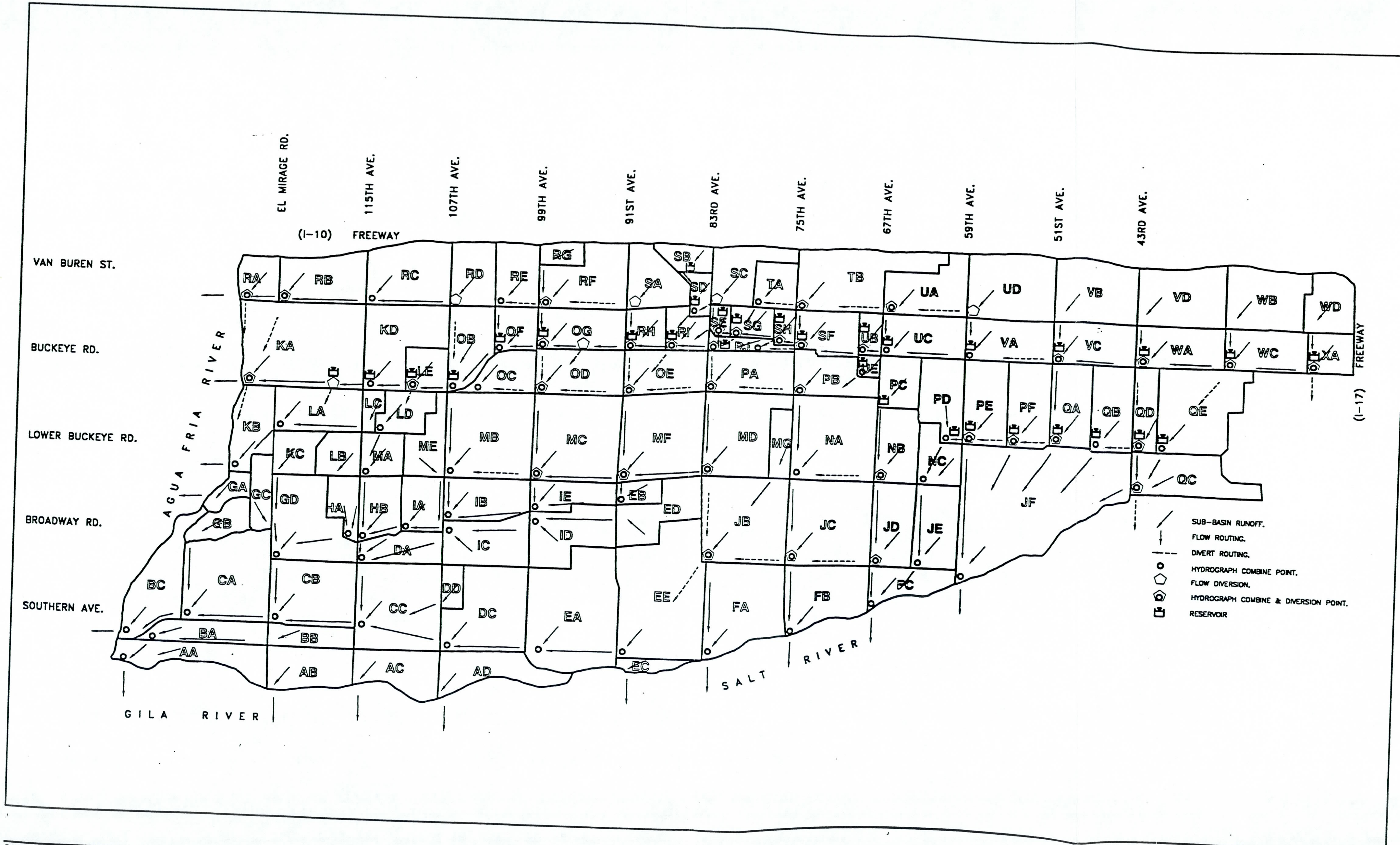

Figure 2 - Drainage Subareas

soil type within each subbasin for input into the DDMS. Soil types are shown on **Figure 3** for the watershed area. Appendix B of DDM1 contains XKSAT values for all soil Map Unit Numbers contained in the Soil Survey.

Land use information was originally obtained from the Salt River Project and updated by the Flood Control District based on field observations and Landiscor aerial photographs. The land use was then input into the District's GIS system to generate the area of each land use type within each subbasin for input into the DDMS. The soil loss parameters are adjusted based on the effective impervious area and the percent of vegetative cover. Current land use is shown on **Figure 4** for the watershed area. Representative values used for each land use classification are shown in **Table 1**.

TABLE 1 - LAND USE PARAMETER DEFAULT VALUES

Land Use	Soil Condition (DTHETA)	Vegetation Cover (%)	Impervious Area (%)	Initial Abstraction (in.)	Mean Mann. n Kn	Roughness Category
Crops	Saturated	80	0	.50	0.10	Hi
Stockyards	Normal	10	0	.50	0.10	Hi
Citrus	Normal	80	0	.70	0.10	Hi
River	Normal	90	0	.20	0.20	Max
Vacant (Desert)	Dry	15	0	.35	0.02	Min
Freeway/Canal	Normal	10	10	.20	0.01	Min
Low Dens. Res	Normal	50	15	.20	0.05	Low
Med Dens. Res	Normal	50	30	.15	0.05	Low
High Dens. Res	Normal	60	40	.15	0.05	Low
Mobile Home	Normal	50	50	.10	0.05	Low
Gen. Industrial	Normal	70	55	.10	0.03	Min
Light Industrial	Normal	60	55	.10	0.03	Min
Power Station	Normal	60	55	.20	0.03	Min
Railroad	Normal	10	25	.10	0.03	Min
Med. Intens. Comm	Normal	75	90	.15	0.02	Min

Land Use	Soil Condition (DTHETA)	Vegetation Cover (%)	Impervious Area (%)	Initial Abstraction (in.)	Mean Mann. n Kn	Roughness Category
Comm Warehouse	Normal	75	90	.05	0.02	Min
Low Intens. Comm	Normal	80	90	.15	0.02	Min
School	Normal	75	40	.20	0.02	Min
Religious	Normal	75	65	.15	0.02	Min
Public Facilities	Normal	75	65	.15	0.02	Min
Park	Normal	90	0	.20	0.10	Hi

The subbasin parameters input into the HEC-1 model are summarized in **Table 2**. The detailed breakdown of loss parameter data generated by the DDMS for each subbasin is contained in the **Appendix**.

TABLE 2 - SUBBASIN INPUT PARAMETERS

SUBBASIN	AREA sq.miles	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %	LAG mins.
SUBAA	0.496	0.450	0.070	4.70	0.440	0	130.0
SUBVD	0.696	0.150	0.160	9.70	0.060	38	36.5
SUBWD	0.367	0.210	0.190	6.80	0.190	9	43.1
SUBAB	0.459	0.360	0.120	5.60	0.310	5	69.7
SUBAC	0.457	0.440	0.050	5.30	0.350	1	75.9
SUBAD	0.463	0.490	0.030	5.20	0.360	0	74.5
SUBBA	0.345	0.390	0.100	5.10	0.350	5	82.1
SUBBB	0.245	0.460	0.070	7.60	0.130	0	62.2
SUBBC	0.612	0.470	0.070	5.10	0.360	0	99.7
SUBCA	0.974	0.490	0.000	8.80	0.090	0	91.0
SUBCB	0.740	0.490	0.010	9.70	0.070	1	71.6
SUBCC	0.980	0.380	0.140	6.20	0.210	5	56.3
SUBDA	0.330	0.410	0.110	6.80	0.170	3	51.6
SUBDC	0.837	0.470	0.040	6.00	0.260	1	63.7
SUBDD	0.126	0.500	0.060	4.65	0.430	0	36.4
SUBEA	1.317	0.500	0.020	5.30	0.340	0	86.9
SUBEB	0.139	0.500	0.000	6.20	0.250	0	42.8
SUBEC	0.109	0.210	0.250	4.50	0.510	20	72.3
SUBED	0.477	0.500	0.000	5.70	0.300	0	84.3
SUBEE	1.470	0.390	0.130	5.10	0.340	13	78.2

SUBBASIN	AREA sq.miles	IA in.	DTHETA	PSIF	XKSAT adj.	RTIMP %	LAG mins.
SUBWC	0.470	0.150	0.160	9.70	0.060	45	32.9
SUBWB	0.674	0.160	0.150	9.70	0.060	36	37.2
SUBXA	0.248	0.120	0.150	9.70	0.060	45	23.6
SUBIB	0.464	0.500	0.000	8.40	0.110	0	73.6
SUBUE	0.070	0.350	0.090	10.10	0.040	9	17.3

E. Unit Hydrograph

The Agricultural S-graph is used to develop the unit hydrograph for all subbasins in the watershed. Guidance is provided in DDM1 for application of the Agricultural S-graph. The MCUHP2 module of the DDMS is used to develop the unit hydrographs for each subbasin for input into the HEC-1 model. The S-graph procedure requires computation of the subbasin lag. The equation used to compute lag is:

$$LAG = 24\ K_n \left(\frac{L \times L_{ca}}{S^{0.5}} \right)^{0.38}$$

Where			
	Lag	=	lag time, hrs
	L	=	length of longest flow path, miles
	L_{ca}	=	length along L to a point opposite of the centroid, miles
	S	=	flow path slope, ft/mile
	K_n	=	resistance coefficient

MCUHP2 computes the resistance coefficient, K_n, for each subbasin based on K_n values assigned to each land use type within the study area. The K_n values and roughness category used for each land use type is shown in **Table 1**. The parameters used to compute lag time and the resulting lag times used in the HEC-1 model are summarized in **Table 3**.

SUBBASIN	S-Graph Type	Kn	L miles	Lca miles	Slope ft/mile	Lag min
SUBRF	Agricultural	0.0680	1.21	0.68	11.60	57.1
SUBRG	Agricultural	0.0970	0.56	0.28	14.30	41.7
SUBRH	Agricultural	0.1000	0.64	0.32	15.60	46.8
SUBRI	Agricultural	0.0790	0.57	0.19	19.30	27.9
SUBRJ	Agricultural	0.0450	0.72	0.42	5.60	29.7
SUBSA	Agricultural	0.0470	0.83	0.30	9.60	26.0
SUBSB	Agricultural	0.0870	0.53	0.27	15.10	35.7
SUBSC	Agricultural	0.0840	1.32	0.68	15.20	69.2
SUBSD	Agricultural	0.0910	0.57	0.34	12.30	43.6
SUBSE	Agricultural	0.0420	0.34	0.17	26.50	11.0
SUBSF	Agricultural	0.0970	0.87	0.44	9.20	63.6
SUBSG	Agricultural	0.0770	0.60	0.30	5.00	42.6
SUBSH	Agricultural	0.0990	0.45	0.23	11.10	38.1
SUBTA	Agricultural	0.0970	0.76	0.37	10.50	55.2
SUBTB	Agricultural	0.0620	1.97	0.79	10.20	67.9
SUBUA	Agricultural	0.0490	1.21	0.57	14.90	36.7
SUBUB	Agricultural	0.0480	0.80	0.40	16.20	30.3
SUBUC	Agricultural	0.0440	1.02	0.51	12.70	30.5
SUBUD	Agricultural	0.0600	1.25	0.63	20.00	44.7
SUBVA	Agricultural	0.0290	1.06	0.53	8.50	22.3
SUBVB	Agricultural	0.0670	1.10	0.55	11.80	49.9
SUBVC	Agricultural	0.0280	1.06	0.53	8.50	21.6
SUBWA	Agricultural	0.0250	1.10	0.55	9.10	19.6
SUBWC	Agricultural	0.0370	1.17	0.59	6.00	32.9
SUBWB	Agricultural	0.0480	1.17	0.58	12.00	37.2
SUBXA	Agricultural	0.0410	0.76	0.38	10.50	23.6
SUBIB	Agricultural	0.1000	1.13	0.57	14.20	73.6
SUBUE	Agricultural	0.0660	0.34	0.17	26.50	17.3

F. Channel Routing

Channel Routing is modeled using the normal depth routing option within HEC-1. The normal depth option uses an 8-point cross-section which is representative of the routing reach. Outflows are computed for normal depth using Manning's equation. Storage is cross-sectional area times reach length. Storage and outflow values are computed for 20 evenly spaced stages beginning at the lowest point on the cross-section to a specified maximum stage. The cross-section is extended vertically at each end to the maximum stage. Three typical cross-sections were developed to depict the types of overland routing that occur within the Tolleson area. The channel types used are shown on **Figure 5**. The type A channel section is used for sheet flow conditions as would occur through agricultural fields or open space with no defined channel section. The type B channel section is used for flow along roadways. The section includes a raised roadway section and grader ditches on each side with the sides extended in each direction to include runoff extending beyond the right-of-way into adjacent fields or open space. The type C channel section is used for flow along an embankment as would occur for flows traversing the SPRR or RID Canal. All routing within the HEC-1 model was classified as type A, B, or C. A summary of the routing parameters used for each channel routing operation in the HEC-1 file is contained in the **Appendix**.

Runoff drains generally in a southwesterly direction. As overland flow reaches major intersections there is sometimes a flow split with a portion of the flow draining south and a portion draining west along the intersecting roads. At some point along the roads, the flow may overtop and proceed along the original southwesterly flow direction. This flow condition is modeled by using the divert option within HEC-1. At intersections where diverts occur, the percentage of flow going each direction is specified. It is recognized that in reality not all the runoff will reach the intersection and not all the runoff will be diverted the entire distance to the next concentration point. However, the HEC-1 model is limited to modeling each hydrograph at a specific concentration point. The modeling of flow splits and subsequent flow routing along sub-basin boundaries is representative of the broad, overland nature of the true flow conditions.

The actual flow split ratios at intersections are determined by estimating the overland flow angle of approach to the intersection and determining the percentage of the flow that would encounter a north-south street and an east-west street of the specified length. The approach angle is estimated based on the resultant of the slopes of each street according to the equation

$$Angle = \arctan\left(\frac{Slope_{n-s}}{Slope_{e-w}}\right)$$

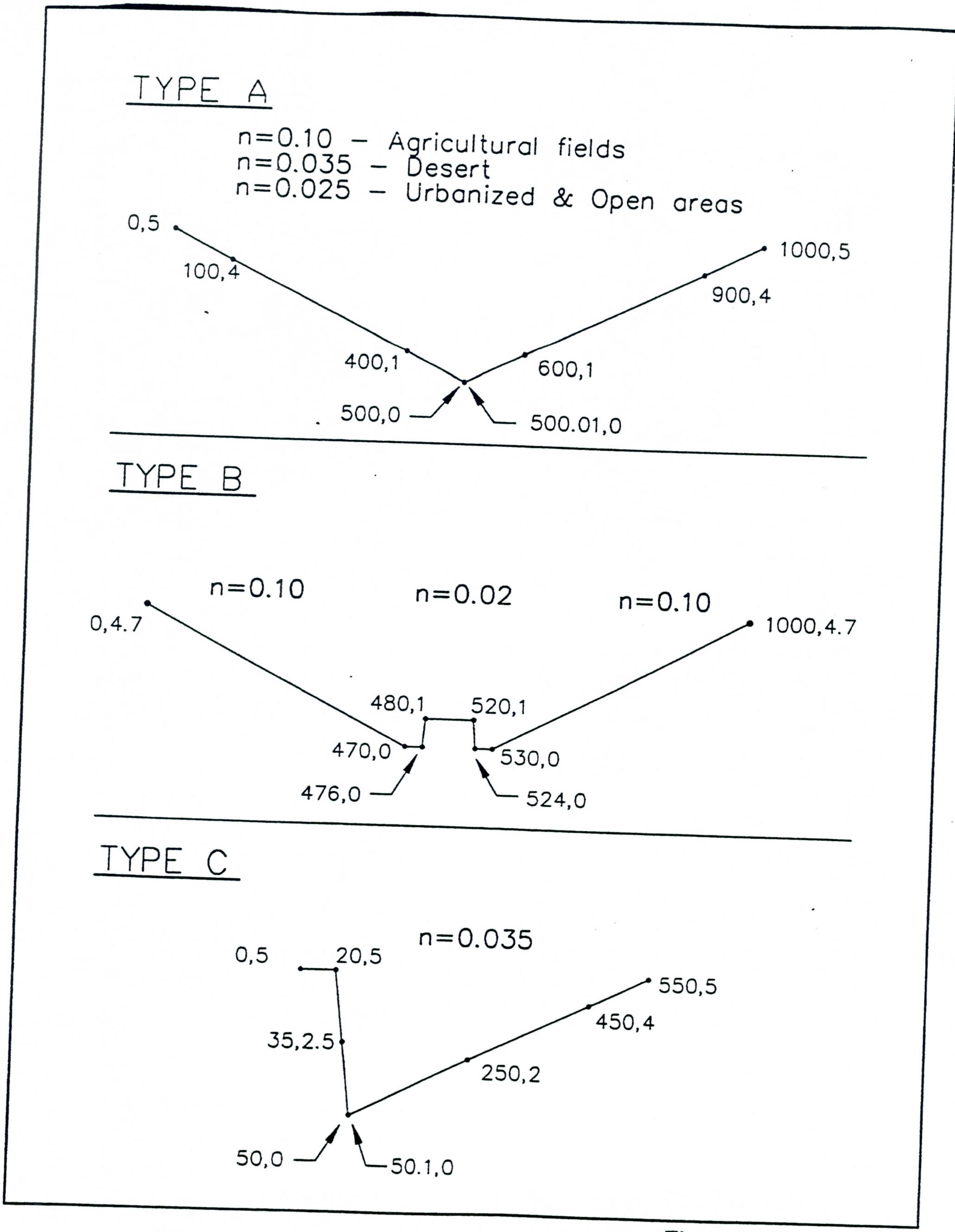

Figure 5 - Channel Types

The flow ratio (FR) is computed according to the following equation:

$$FR_s = \frac{\dfrac{L_{e-w}}{S_{e-w}}}{\dfrac{L_{e-w}}{S_{e-w}} + \dfrac{L_{n-s}}{S_{n-s}}}$$

Where:

FR_s = Flow ratio for flow going to the south, across the east - west street.
L_{e-w}, L_{n-s} = East - west and north - south street lengths, respectively (ft)
S_{e-w}, S_{n-s} = East - west and north - south street slopes, respectively (ft/ft)

The derivation of flow split values is summarized in **Table 4**.

TABLE 4 - FLOW SPLIT ANALYSIS

Subarea	E-W Street (ft)		N-S Street (ft)		Flow Ratio		Flow Angle
Designation	Length	Delta Y	Length	Delta Y	To South	To West	(deg)
UD	5280	8	2640	6.2	0.76	0.24	57
UA	5280	7	2640	6.59	0.79	0.21	62
TB	5280	9.6	2640	6.91	0.74	0.26	55
SC	2640	5	2640	4.2	0.46	0.54	40
SA	3960	8.9	2640	3.98	0.50	0.50	34
RF	5280	6	2640	5.9	0.80	0.20	63
RD	2640	2.7	3960	3.9	0.39	0.61	44
QC	5280	7.4	2640	6.8	0.79	0.21	61
NB	2640	7.07	5280	15.02	0.35	0.65	47
JD	2640	1.7	2640	2.9	0.63	0.37	60
PB	5280	6.65	2640	7.3	0.81	0.19	66
JC	5280	11.4	5280	13.5	0.54	0.46	50
PA	5280	13.29	2640	15.53	0.82	0.18	67
MD	2640	6.6	2640	1.8	0.21	0.79	15
JB	5280	9.08	5280	16.35	0.64	0.36	61
OE	5280	7.4	2640	8.73	0.83	0.17	67
OD	5280	6.47	2640	7.3	0.82	0.18	66
MC	5280	7.9	5280	12.3	0.61	0.39	57
MF	5280	12.1	5280	10.87	0.47	0.53	42

Notes: Flow split is at the southwest corner of the drainage area.
Flow angle is measured counter-clockwise from the east-west street.
Delta Y is the elevation difference corresponding to the specified street length.

G. Storage Routing

Ponding behind the RID Canal and the SPRR is modeled using Modified Puls storage routing to determine peak discharge attenuation and ponding elevations. The HEC-1 input for storage routing requires a stage-storage-discharge relationship. The stage-storage relationships were developed using Eagle Point software with the three dimensional mapping files for each ponding area. The Eagle Point output consists of total cumulative storage volume at a range of elevations from the lowest elevation in the ponding area to a point above the overflow elevation.

The stage-discharge relationships were developed using a weir equation to analyze flow over the SPRR, RID canal, or approach roadways. Profiles for weir sections used for floodplain mapping were obtained from field surveyed profiles with elevation shots taken at approximately 100 foot intervals. Profiles for weir sections used only for storage routing to determine peak discharge attenuation were taken from the three dimensional mapping. In many cases break lines along the weir sections were used from the DTM file. The stage-storage-discharge data used for storage routing is contained in the **Appendix**.

H. HEC-RAS Analysis

The preliminary HEC-1 modeling results indicated that the ponding areas typically did not extend upstream to the next adjacent ponding area. HEC-1 routing further indicated that during the 100-year event, significant peak flows pass between adjacent ponding areas that would not be depicted by mapping only the ponding limits. Therefore, detailed mapping of the riverine and sheet flow between adjacent ponding areas was performed using the HEC-RAS model.

Initial HEC-RAS modeling results did not fully support the following assumptions made for the preliminary HEC-1 modeling at several of the ponding areas along the SPRR and RID:

- *Flow over the north-south drainage divides at the SPRR and RID ponding areas occurs as weir flow.* Flow over the north-south weir was found to be submerged, or controlled by backwater, at several of the ponding areas modeled by detailed methods.

- *Flow between adjacent ponding areas is contained by the SPRR and RID embankments.* HEC-RAS profiles indicated that overflow to the south occurs at several points between a few of the ponding areas modeled by detailed methods.

The HEC-1 modeling was coordinated with the HEC-RAS analysis in the following ways:

First, weir calculations were used to establish the stage-storage-discharge relationships for each ponding area to be modeled in the preliminary HEC-1 models. Then, the outflow and diversion discharge rates estimated from the preliminary HEC-1 level pool routing through ponding areas were used for the preliminary HEC-RAS models. Second, where the HEC-RAS modeling indicated that the flow over the north-south roadways was submerged, the weir relationships used in the HEC-1 were replaced with rating curves based on HEC-RAS results. The HEC-1 model was then re-run to obtain revised discharge rates for use in the HEC-RAS models of the flow reaches between adjacent ponding areas. Where the HEC-RAS model indicated that flow over the weirs was not submerged, known water surface elevations based on the irregular weir calculations were entered into the HEC-RAS model. Third, where the HEC-RAS model indicated that the SPRR or RID could not contain flow along the embankment between the ponding areas (due to obstructions or lack of conveyance area), additional divert routines were added to the HEC-1 model to account for flow over the embankment between the ponding areas mapped by detailed methods.

III. RESULTS

The computed peak discharges for each subarea and at all concentration points are summarized in **Table 5** which shows the peak flow, time to peak, volume, and area. The last column shows the unit peak discharge per square mile as a means for comparison. The unit peak discharge ranges from zero for zero flow diverted hydrographs to a maximum of 3,843 cfs/sm with an average of 553 cfs/sm. The subbasin routing used is shown on **Figure 2** with the drainage subareas. The same exhibit is presented at a 2000 scale as **Exhibit 2** folded in the envelope at the back of the report. The HEC-1 input listing, schematic diagram, and output summary are contained in the **Appendix**.

TABLE 5 - PEAK DISCHARGE SUMMARY

KK ID	Peak Flow cfs	Time to Peak (hrs)	Volume ac-ft	Area sq. mi.	Unit Pk cfs/sm
SUBWD	329	12.50	30	0.37	889
SUBXA	395	12.17	37	0.25	1580
CPXA1	452	12.50	67	0.62	729
CPZZ1	445	12.58	67	0.62	718
SUBWB	791	12.42	92	0.67	1181
SUBWC	609	12.33	69	0.47	1296
CPWC	1325	12.50	224	1.76	753
CPWC2	1126	12.83	206	1.76	640
SUBVD	826	12.33	96	0.70	1180
SUBWA	868	12.17	65	0.49	1771
CPWA	1540	13.17	359	2.95	522
CPWA2	1520	13.25	357	2.95	515
SUBVB	1340	12.58	166	0.72	1861
SUBVC	683	12.17	59	0.49	1394
CPVC	2369	13.42	571	4.16	569
CPVC2	1698	13.50	365	4.16	408
SUBQA	517	12.50	62	0.49	1055
CPQA2	1755	13.75	423	4.65	377
SUBQE	1061	12.42	132	0.90	1179
CPQE	0	0.00	0	1.76	0
CPQE2	1061	12.42	132	0.90	1179
SUBQD	521	12.17	48	0.27	1930
CPQD	0	0.00	0	2.95	0
CPQD1	521	12.17	48	0.27	1930
CPQD2	370	12.17	40	0.27	1370
SUBQC	541	12.42	66	0.60	902
CPQC	1645	12.67	223	1.77	929
CPQC2	329	12.67	45	1.77	186
SUBJF	1077	13.42	256	2.25	479
CPJF1	1071	13.42	292	4.02	266
SUBQB	599	12.42	71	0.51	1175
CPQB	112	12.17	5	0.27	415
CPQB1	600	12.42	76	0.78	769
SUBPF	649	12.33	69	0.50	1298
CPPF	565	13.75	170	4.65	122
CPPF1	666	12.33	235	5.78	115
CPPF2	584	14.17	201	5.78	101
SUBPE	800	12.17	77	0.50	1600
CPPE	641	12.50	76	0.50	1282
CPPE2	623	12.50	270	6.28	99

KK ID	Peak Flow cfs	Time to Peak (hrs)	Volume ac-ft	Area sq. mi.	Unit Pk cfs/sm
CPPE3	603	14.92	249	6.28	96
CPJF2	1850	16.08	807	10.17	182
SUBPC	459	12.17	31	0.29	1583
SUBNB	346	12.67	36	0.44	786
CPNB1	349	12.67	46	0.73	478
CPNB2	124	12.67	16	0.73	170
SUBJD	358	12.83	49	0.49	731
CPJD	357	12.83	64	1.22	293
CPJD1	226	12.83	41	1.22	185
SUBPD	400	12.58	41	0.45	889
CPPD	0	14.75	0	6.28	0
CPPD2	400	12.58	41	0.45	889
SUBNC	269	12.50	22	0.31	868
CPNC	266	12.50	27	0.76	350
SUBJE	391	12.75	53	0.50	782
CPJE	491	13.17	78	1.26	390
SUBFC	287	12.67	33	0.34	844
CPFC	820	13.25	150	2.82	291
CPFC1	1868	16.08	937	12.99	144
SUBUD	784	12.50	85	0.78	1005
CPUD	594	12.50	64	0.78	762
SUBVA	809	12.17	78	0.49	1651
CPVA	630	13.50	154	4.16	151
CPVA2	918	13.67	295	1.27	723
SUBUA	646	12.42	65	0.56	1154
CPUA	190	12.50	21	0.78	244
CPUA1	646	12.42	86	1.33	486
CPUA2	513	12.42	68	1.33	386
SUBUC	636	12.25	58	0.48	1325
CPUC	1164	12.92	393	7.10	164
SUBUB	182	12.25	16	0.14	1300
CPUB	1153	13.08	399	7.24	159
CPUB1	1020	13.33	366	7.24	141
SUBTB	606	12.83	88	0.89	681
CPTB	128	12.42	17	1.33	96
CPTB1	666	12.92	103	2.19	304
CPTB2	504	12.92	78	2.19	230
SUBSF	297	12.75	44	0.37	803
CPSF1	1552	13.58	478	8.46	183
CPSF2	1043	13.75	327	8.46	123
SUBSH	127	12.42	14	0.11	1155
CPSH	942	14.08	336	8.57	110

KK ID	Peak Flow cfs	Time to Peak (hrs)	Volume ac-ft	Area sq. mi.	Unit Pk cfs/sm
CPSH1	157	14.25	69	8.57	18
SUBTA	211	12.67	22	0.27	781
CPTA	162	12.92	25	2.19	74
CPTA1	252	13.08	46	2.46	102
SUBSG	186	12.42	20	0.18	1033
CPSG	358	12.67	133	9.02	40
CPSG1	91	12.83	40	9.02	10
SUBSC	229	12.83	28	0.43	533
CPSC	105	12.83	13	0.43	244
SUBSE	163	12.08	5	0.09	1811
CPSE	160	13.42	57	9.54	17
CPSE2	0	0.00	0	9.54	0
SUBRJ	186	12.25	15	0.14	1329
CPRJ1	447	13.75	140	8.46	53
CPRJ2	773	14.25	241	8.57	90
CPRJ3	1171	14.25	379	8.57	137
CPRJ4A	262	12.83	79	9.02	29
CPRJ4B	1334	14.58	453	8.57	156
CPRJ5	139	13.92	46	9.54	15
CPRJ6	1423	14.83	506	9.68	147
CPRJ7	979	15.17	432	9.68	101
CPRI1	740	15.25	352	9.68	76
SUBUE	132	12.08	9	0.07	1886
CPUE	48	13.33	8	7.24	7
CPUE2	132	12.08	19	0.07	1886
SUBPB	439	12.42	43	0.42	1045
CPPB1	438	12.42	45	0.49	894
CPPB2	357	12.42	36	0.49	729
SUBNA	608	13.00	99	0.98	620
CPNA1	226	12.67	30	0.73	310
CPNA2	751	13.42	163	1.47	511
SUBJC	1153	13.00	170	0.99	1165
CPJC1	130	12.83	24	1.22	107
CPJC2	1284	13.42	352	2.46	522
CPJC3	694	13.42	190	2.46	282
SUBFB	449	12.67	52	0.66	680
CPFB	737	13.67	239	3.12	236
CPFB1	0	0.00	0	3.12	0
SUBPA	461	12.50	53	0.49	941
CPPA	81	12.42	8	0.49	165
CPPA2	350	15.17	64	9.68	36
CPPA3	461	12.50	133	0.49	941

KK ID	Peak Flow cfs	Time to Peak (hrs)	Volume ac-ft	Area sq. mi.	Unit Pk cfs/sm
CPPA	378	12.50	109	0.49	771
SUBMD	509	13.00	88	0.80	636
CPMD	511	13.00	190	1.29	396
CPMD1	407	13.00	151	1.29	316
CPMD2	0	0.00	0	1.29	0
CPMD3	0	0.00	0	9.68	0
SUBMG	176	12.67	20	0.20	880
SUBJB	531	12.92	76	0.98	542
CPJB	530	12.92	95	1.18	449
CPJB1	591	13.42	162	2.46	240
CPJB2	104	13.00	39	1.29	81
CPJB3	791	14.75	294	1.18	670
CPJB4	506	14.75	188	1.18	429
SUBFA	217	14.00	58	0.88	247
CPFA	526	16.33	231	2.06	255
CPFA1	0	0.00	0	2.06	0
CPRI3	739	15.33	349	9.68	76
SUBRI	318	12.25	21	0.23	1383
SUBSB	229	12.33	21	0.19	1205
SUBSD	137	12.50	12	0.14	979
CPSD1	124	12.83	15	0.43	288
CPSD2	429	12.58	46	0.76	564
CPRI5	759	15.33	413	10.24	74
SUBSA	620	12.25	48	0.42	1476
CPSA	310	12.25	24	0.42	738
SUBRH	225	12.50	26	0.22	1023
CPRH	779	13.08	449	10.89	72
CPRH2	780	13.08	446	10.89	72
CPOG1	776	13.17	443	10.89	71
SUBRG	143	12.42	15	0.13	1100
SUBRF	528	12.67	63	0.63	838
CPRF	310	12.25	24	0.42	738
CPRF1	542	12.67	100	1.18	459
CPRF2	434	12.67	80	1.18	368
SUBOG	475	12.50	58	0.47	1011
CPOG	1236	13.50	563	12.12	102
CPOG2	847	13.58	418	12.12	70
SUBOF	263	12.50	27	0.25	1052
SUBRE	242	12.92	36	0.36	672
CPRE	108	12.67	20	1.18	92
CPRE1	244	13.00	55	1.55	157
CPOF1	1091	13.75	491	12.73	86

KK ID	Peak Flow cfs	Time to Peak (hrs)	Volume ac-ft	Area sq. mi.	Unit Pk cfs/sm
SUBOB	250	12.83	31	0.44	568
SUBRD	245	12.83	31	0.38	645
CPRD	147	12.83	18	0.38	387
SUBRC	394	12.92	56	0.68	579
CPRC	392	12.92	74	1.06	370
SUBRB	350	12.67	38	0.55	636
CPRB	418	13.75	110	1.61	260
CPRB1	209	13.75	55	1.61	130
SUBRA	158	12.67	16	0.24	658
CPRA	154	12.67	67	1.85	83
CPRA1	25	12.67	22	1.85	14
CPRA2	0	0.00	0	1.85	0
CPOB2	98	12.83	12	0.38	258
CPOB3	933	14.58	451	13.55	69
SUBLE	212	12.42	20	0.25	848
CPLE	632	18.08	367	13.80	46
CPLE1	443	18.25	262	13.80	32
SUBKD	330	13.00	52	0.72	458
CPKD	441	18.58	299	14.52	30
CPKA2	216	22.17	112	14.52	15
SUBKA	532	13.08	88	1.38	386
CPKA3	209	13.75	55	1.61	130
CPKA4	130	12.67	45	1.85	70
CPKA5	679	13.42	268	15.90	43
CPKA6	388	13.33	246	15.90	24
SUBEC	54	12.83	9	0.11	491
SUBAD	236	12.83	31	0.46	513
SUBAC	235	12.92	32	0.46	511
SUBAB	250	12.83	33	0.46	543
CPSR7	1100	12.92	342	17.39	63
SUBOE	355	12.67	40	0.49	724
CPOE1	83	12.50	24	0.49	169
CPOE2	0	0.00	0	10.89	0
CPOE3	239	15.25	78	9.68	25
CPOE4	356	12.67	143	0.49	727
CP0E5	297	12.67	119	0.49	606
SUBMF	578	13.08	103	0.97	596
CPMF	407	13.00	151	1.29	316
CPMF1	814	14.00	355	1.46	558
CPMF2	438	14.00	190	1.46	300
SUBOD	447	12.67	62	0.53	843
CPOD1	59	12.67	24	0.49	120

KK ID	Peak Flow cfs	Time to Peak (hrs)	Volume ac-ft	Area sq. mi.	Unit Pk cfs/sm
CPOD2	0	0.00	0	10.89	0
CPOD3	358	13.58	135	12.12	30
CPOD4	498	12.75	199	31.55	16
CPOD5	409	12.75	163	31.55	13
SUBMC	643	13.00	114	1.00	643
CPMC1	810	14.33	405	34.01	24
CPMC2	500	14.33	249	34.01	15
SUBEB	137	12.42	12	0.14	979
CPEB1	376	14.00	165	1.46	258
CPEB2	395	14.00	184	0.14	2821
SUBIE	201	12.83	31	0.30	670
CPIE	804	14.75	414	34.45	23
SUBOC	421	12.25	37	0.31	1358
CPOC1	90	12.75	36	31.55	3
CPOC2	421	12.25	74	0.31	1358
SUBMB	631	12.92	105	0.99	637
CPMB	310	14.33	156	34.01	9
CPMB1	839	13.25	334	1.30	645
SUBIB	326	12.92	51	0.46	709
CPIB	1258	14.83	712	36.21	35
SUBME	218	12.67	24	0.32	681
SUBIA	281	12.50	25	0.31	906
CPIA	1340	14.17	751	36.84	36
SUBLD	314	12.25	29	0.28	1121
CPLD	187	18.25	79	13.80	14
CPLD	314	12.25	119	14.10	22
SUBMA	185	12.50	17	0.25	740
CPMA	447	12.50	118	14.35	31
SUBHB	271	12.50	23	0.34	797
CPHB	1395	14.17	833	51.53	27
SUBED	250	13.00	38	0.48	521
SUBID	340	12.83	42	0.56	607
CPID	337	12.83	77	1.04	324
SUBIC	244	13.00	37	0.53	460
CPIC	483	13.58	111	1.57	308
SUBDA	267	12.58	27	0.33	809
CPDA	1759	14.33	937	53.43	33
SUBEE	704	12.92	115	1.40	503
CPEE1	285	14.75	106	1.18	242
CPEC	705	12.92	219	1.40	504
SUBEA	607	13.00	93	1.30	467
CPEA	1232	13.25	306	2.70	456

KK ID	Peak Flow cfs	Time to Peak (hrs)	Volume ac-ft	Area sq. mi.	Unit Pk cfs/sm
SUBDC	545	12.75	64	0.84	649
CPDC	1126	14.42	356	3.54	318
SUBDD	118	12.33	8	0.13	908
SUBCC	691	12.67	75	0.98	705
CPCC	2511	15.67	1207	58.08	43
SUBLB	171	12.67	17	0.25	684
SUBHA	359	12.42	30	0.22	1632
CPHA	356	12.42	47	0.47	757
SUBKC	385	12.58	35	0.26	1481
SUBGD	592	12.67	67	0.77	769
SUBGC	243	12.25	17	0.21	1157
CPGD	717	13.58	163	1.71	419
SUBCB	540	12.92	87	0.74	730
CPCB	2652	16.50	1337	60.53	44
SUBGB	237	12.25	17	0.23	1030
SUBCA	587	13.08	114	0.97	605
CPCA	2565	17.67	1344	61.73	42
SUBBC	235	13.17	41	0.61	385
CPBC	2547	18.00	1340	62.34	41
SUBLC	109	12.33	7	0.10	1090
SUBLA	266	12.83	36	0.50	532
CPLA	119	22.17	43	14.52	8
CPLA	293	13.00	92	0.60	488
SUBKB	322	12.50	29	0.42	767
CPKB	291	13.42	23	15.90	18
CPKB1	435	14.25	141	1.02	426
SUBGA	258	12.08	10	0.14	1843
SUBBB	179	12.75	21	0.25	716
SUBBA	161	12.92	25	0.34	474
CPBA	160	12.92	46	0.59	271
CPAA	273	13.17	76	1.09	250
					Average = 539
					Max = 2821

A. Comparison of the Results With Other Studies and/or Stream gages

The only other report that prepared hydrology for the study area is the 1978 Flood Insurance Study for the City of Tolleson. The resulting report did not present peak discharges. There are no known stream gages within the watershed. Therefore, there is no basis for comparison of results.

B. Conclusions

This hydrologic model was developed primarily for the purpose of delineating flood hazards behind the RID Canal and the SPRR. Quite detailed mapping along with sophisticated three-dimensional DTM terrain computer modeling techniques were used to develop the stage-storage relationships and HEC-RAS cross-sections. Field surveys were used to establish profiles for weir calculations at overflow boundaries. Therefore it is felt that the model can be used to delineate riverine and ponding inundation areas with reasonable confidence within the limitations of the methods employed. The JD options within HEC-1 were used to simulate the areal reduction in point precipitation values based on the accumulated drainage area. Even with this refinement, application of this model to other areas within the watershed and for other purposes should include analysis of other storm durations and centerings such as the six hour storm with rainfall patterns as described in DDM1.

The Modified Puls routing of runoff ponded behind the RID Canal and the SPRR generates maximum ponded water surface elevations. The water surface elevations generated in the HEC-1 model are used as a basis for floodplain delineation in areas not modeled with HEC-RAS. The weir hydraulic calculations and HEC-RAS modeling are presented in the companion *Final Report and Technical Data Notebook.*

APPENDIX E-4: Excerpts from Floodplain Delineation of the Tolleson Area – Final Report and Technical Data Notebook

FLOOD CONTROL DISTRICT
OF
MARICOPA COUNTY

2801 WEST DURANGO STREET
PHOENIX, ARIZONA 85009

FLOODPLAIN DELINEATION OF THE TOLLESON AREA

FINAL REPORT

AND

TECHNICAL DATA NOTEBOOK

FCDMC CONTRACT NO. 95-26

May, 1999

Registered Professional Engineer (Civil)
CERTIFICATE NO.
21694
BRIAN J.
FRY
Date Signed 5-24-99
ARIZONA, U.S.A.

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Flood Control District of Maricopa County
Tolleson Area Floodplain Delineation Study

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Tolleson Area Floodplain Delineation Study

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See Hydrology Report

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Hydraulics Work Study Maps

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Tolleson Area Floodplain Delineation Study

Section 1.0: Introduction

1.1 Purpose of Study

This Flood Delineation Study revises and updates information on the existence and severity of flood hazards by using detailed methods for the ponding areas upstream of the Roosevelt Irrigation District canal (RID) and the Southern Pacific Railroad (SPRR) in west-central Maricopa County, Arizona. The floodplains along the RID and SPRR were previously studied by approximate methods. Since the time of the original study, the methodology for hydrologic modeling has been revised by Maricopa County and new topographic mapping has been developed. This re-study includes new hydrologic modeling of the watershed, as well as detailed mapping of ponding areas upstream of the RID and portions of the SPRR. The study area includes portions of the City of Tolleson, the City of Phoenix, the City of Avondale, and unincorporated Maricopa County.

The City of Tolleson, the City of Phoenix, the City of Avondale and Maricopa County will use the information in this floodplain delineation study to regulate floodplain development, to promote sound land use practices, and for floodplain management.

1.2 Authority for Study

The hydrologic and hydraulic analyses for this study were performed by Dibble & Associates, in association with their subcontractors, JE Fuller/ Hydrology & Geomorphology, Inc. (JEF), and Urban Engineering (UE), for the Flood Control District of Maricopa County (FCDMC), under contract #FCD 95-26. The project managers for the Tolleson Area Floodplain Delineation Study were Tim Murphy/ FCDMC and Brian Fry/ Dibble. This study was completed in March 1999.

1.3 Location of Study

The Tolleson Area FDS study area is located within portions of the City of Phoenix, the City of Tolleson, the City of Avondale, and unincorporated Maricopa County (Figure 1.1). The flooding areas studied are generally located in Township 1 North, Range 1 East (T1N, R1E) and Township 1 North, Range 2 East (T1N, R2E). The Tolleson Area Floodplain Delineation study area includes reaches of ponded urban and agricultural runoff, as well as riverine-like flow upstream of, and parallel to, the SPRR and RID.

Two types of flood-prone areas were identified for the Tolleson Area FDS: (1) ponding

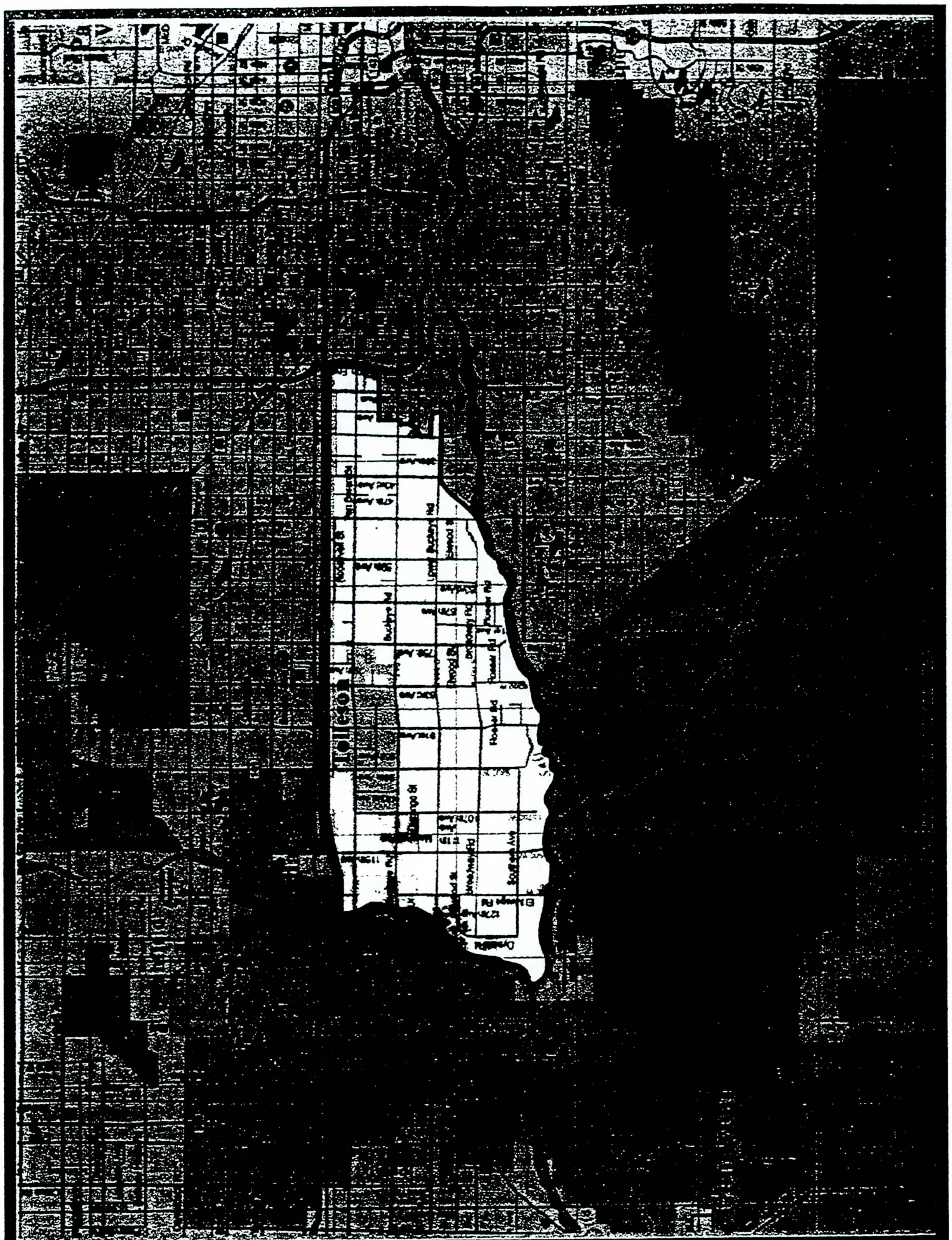


Figure 1.1

reaches, and (2) riverine-like floodplain reaches. Two main obstructions cause ponding within the study area: the RID canal and the SPRR grade (Figure 1.2). The RID flows due west from 35th Avenue to about 59th Avenue, before turning to the northwest along an irregular alignment until it passes under I-10 near 91st Avenue and leaves the study area. The SPRR crosses the study area along an east-west alignment from I-17 to the Agua Fria River. Ponding area reaches mapped using detailed methods for this study include the area upstream of the RID canal between 35th Avenue and I-10, and the area upstream of the SPRR between 69th Avenue and the Agua Fria River. Local ponding areas east of 69th Avenue along the SPRR were identified for hydrologic modeling purposes, but were not mapped as part of this study.

Riverine-type floodplains also occur in the study area. These floodplains are not defined rivers or streams, but consist of unconfined flow between adjacent ponding areas. These riverine-type floodplains occur where storm water runoff flows over the hydraulic control from one ponding area, and flows parallel to the SPRR or the RID, and enters the next downstream ponding area. These floodplains were modeled using the HEC-RAS hydraulic model along the RID/SPRR alignment from 69th Avenue to 83rd Avenue, and along the SPRR alignment from 75th Avenue to the El Mirage Road alignment.

1.4 Summary of Methodology

Floodplain areas are delineated using HEC-1 and HEC-RAS computer models. Ponding areas upstream of the SPRR and RID are modeled using HEC-1 routing subroutines. Hydrographs generated in the HEC-1 model are routed through ponding areas. Storage-elevation relationships for each ponding area are estimated using the FCDMC digital terrain model (DTM). Outflow from ponding areas is modeled using an irregular weir program and surveyed profiles of weirs that contained the ponding areas. Where outflow from the ponding areas is not controlled by weir flow, water surface elevations are modeled using the HEC-RAS model.

For two portions of the study area, from 69th Avenue to 83rd Avenue along the RID/SPRR, and from 75th Avenue to El Mirage Road along the SPRR, riverine-type flow between adjacent ponding areas is modeled using HEC-RAS. Flow between ponding areas consists of low velocity discharge, urban sheet flow, and ineffective flow. Therefore, no floodways are delineated in the flood-prone areas modeled using HEC-RAS. Topographic data for HEC-RAS modeling was obtained from the FCDMC DTM.

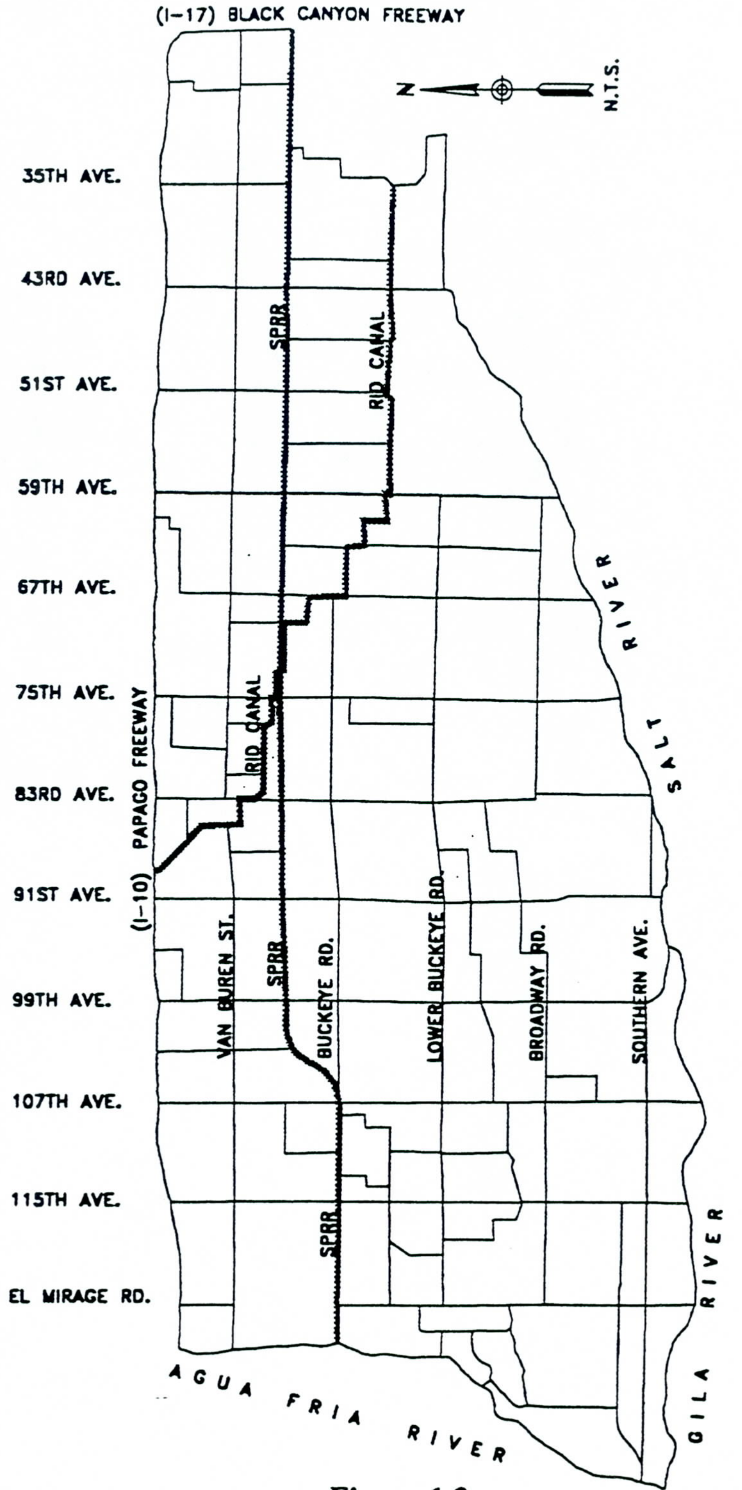

(I-17) BLACK CANYON FREEWAY
N
N.T.S.
35TH AVE.
43RD AVE.
51ST AVE.
59TH AVE.
67TH AVE.
75TH AVE.
83RD AVE.
91ST AVE.
99TH AVE.
107TH AVE.
115TH AVE.
EL MIRAGE RD.
(I-10) PAPAGO FREEWAY
SPRR
RID CANAL
VAN BUREN ST.
BUCKEYE RD.
LOWER BUCKEYE RD.
BROADWAY RD.
SOUTHERN AVE.
SALT RIVER
GILA RIVER
AGUA FRIA RIVER

Figure 1.2

The following agencies were contacted for information. published reports and manuals, and comments during the study:

- Arizona Department of Transportation (ADOT)
- Arizona Department of Water Resources (ADWR)
- Roosevelt Irrigation District (RID)
- Federal Emergency Management Agency (FEMA)
- Flood Control District of Maricopa County (FCDMC)
- Southern Pacific Railroad (SPRR)
- City of Tolleson
- City of Phoenix
- City of Avondale
- U.S. Army Corps of Engineers (COE)
- U.S. Geological Survey (USGS)
- U.S.D.A. Natural Resource Conservation Service (NRCS)

Vertical control data, used to establish the network of elevation reference marks, was obtained from the U.S. Department of Commerce, Coast and Geodetic Survey.

The study was publicized in local newspapers, and subsequent responses from the public were noted or discussed. Letters concerning right-of-entry for surveying purposes were sent to all property owners along the RID and the SPRR. Intermediate review meetings were conducted between the personnel of Dibble & Associates, JEF, UE, and FCDMC.

1.6 Study Results

This study indicates that flooding occurs in areas located upstream of the SPRR and RID embankments in the City of Phoenix, the City of Tolleson, the City of Avondale and unincorporated Maricopa County. Flood Insurance Rate Panels (FIRM) were revised for ponding and riverine-type reaches based on HEC-1 and HEC-RAS modeling.

Section 2.0: FEMA Forms & ADWR Abstracts

The FEMA forms (MT-2 Form 1, 3, 4 and 5) are included at the end of the report text.

STUDY DOCUMENTATION ABSTRACT									
INITIAL STUDY		RESTUDY	x	LOMR		CLOMR		OTHER	

Section 2.1. Study Documentation Abstract for FEMA Submittals

2.1.1	Date Study Accepted	
2.1.2	Study Contractor: Contacts Address Phone Internal Reference No. Subconsultants	Dibble & Associates Brian Fry, P.E. 2633 East Indian School Rd., Suite 401 Phoenix, AZ 85016-6763 (602)957-1155 Dibble Job No. 9532 JEFuller/ Hydrology & Geomorphology, Inc. Urban Engineering
2.1.3	FEMA Technical Review Contractor Address Phone Internal Reference Number	 Michael Baker, Jr., Inc. Alexandria, Virginia (703)960-8800 pending
2.1.4	FEMA Regional Reviewer Phone	Michael K. Buckley, P.E., Chief FEMA Hazard Identification Branch (202)646-3932
2.1.5	State Technical Reviewer Phone	Brian T. Cosson Arizona Department of Water Resources (602)417-4100
2.1.6	Local Technical Reviewer Phone	Timothy M. Murphy Flood Control District of Maricopa County (602)506-1501

2.1.7	Reach Description	a. Roosevelt Irrigation District Canal 35th Avenue to Interstate 10 Approximately 9 miles *FIRM Panels*: 04013C2120 E; 04013C2115 E; 04013C2105 D a. Southern Pacific Railroad 69th Avenue to Agua Fria River near El Mirage Road Approximately 6 miles *FIRM Panels*: 04013C2105 D; 04013C2080 G; 04013C2085 E; 04013C2090 F; 04013C2095 D
2.1.8	USGS Quadrangle Sheets	Fowler, Arizona, 7.5 minute, 10' C.I. Photo Date: 1951 Latest Photo Revision: 1982 Tolleson, Arizona, 7.5 minute, 5' C.I. Photo Date: 1954 Latest Photo Revision: 1982
2.1.9	Unique Conditions and Problems	Ponding, urban sheet flow (non-riverine)
2.1.10	Coordination of Discharges (Agency, Date, Comments)	Local agency approval - See 2.1.6 above

Study Documentation Abstract for Local Government and ADWR Submittals		
Section 2.1: General Information		
2.1.1	Community	Tolleson, Arizona Phoenix, Arizona Avondale, Arizona Maricopa County (Unincorporated), Arizona
2.1.2	Community Number(s)	#040037 (Unincorporated Maricopa County) #040038 (City of Avondale) #040051 (City of Phoenix) #040055 (City of Tolleson)
2.1.3	County	Maricopa
2.1.4	State	Arizona
2.1.5	Date Study Accepted	
2.1.6	Study Contractor: Contacts Address Phone Internal Reference No. Subconsultants:	Dibble & Associates Brian Fry, P.E. 2633 East Indian School Rd., Suite 401 Phoenix, AZ 85016-6763 (602)957-1155 Dibble Job No: 9532 JEFuller/ Hydrology & Geomorphology, Inc. Urban Engineering
2.1.7	State Technical Reviewer Phone	Brian T. Cosson Arizona Department of Water Resources (602)417-4100
2.1.8	Local Technical Reviewer Phone	Timothy M. Murphy Flood Control District of Maricopa County (602)506-1501
2.1.9	River or Stream Name	Tolleson Area - ponding upstream of: a. Roosevelt Irrigation District Canal b. Southern Pacific Railroad

2.1.10	Reach Description	a. Roosevelt Irrigation District Canal 35th Avenue to Interstate 10 Approximately 9 miles *FIRM Panels*: 04013C2120 E; 04013C2115 E; 04013C2105 D a. Southern Pacific Railroad 69th Avenue to Agua Fria River near El Mirage Road Approximately 6 miles *FIRM Panels*: 04013C2105 D; 04013C2080 G; 04013C2085 E; 04013C2090 F; 04013C2095 D
2.1.11	Study Type	Detailed Study of Ponding Areas and Riverine analysis
Section 2.2: Mapping Information		
2.2.1	USGS Quadrangle Sheets	Fowler, Arizona, 7.5 minute, 10' C.I. Photo Date: 1951 Latest Photo Revision: 1982 Tolleson, Arizona, 7.5 minute, 5' C.I. Photo Date: 1954 Latest Photo Revision: 1982
2.2.2	Mapping for Hydrologic Study Type/Source: Scale: Date:	FCDMC Aerial Photography - Kenney Aerial Mapping, Inc. Maryvale ADMS Project Maps 1" = 200', 2 ft. Contour interval March 28, 1994 (Flight Date)
2.2.3	Mapping for Hydraulic Study 1. Type/Source: Scale: Date: 2. Type/Source: Date:	FCDMC Aerial Photography - Kenney Aerial Mapping, Inc. Maryvale ADMS Project Maps 1" = 200', 2 ft. Contour interval March 28, 1994 (Flight Date) Ground survey data along RID & SPRR Urban Engineering April 1996; September 1997; August 1998

Section 2.3: Hydrology		
2.3.1	Model or Method Used	U.S. Army Corps of Engineers' HEC-1 Model, Version 4.1, July 1997 and FCDMC Hydrologic Design Manual.
2.3.2	Storm Duration	24 Hours
2.3.3	Hyetograph Type	SCS Type II
2.3.4	Frequencies Determined	100-year (24-hr)
2.3.5	List of Gages Used in Frequency Analysis or Calibration	No stream gages in study area
2.3.6	Rainfall Amounts and Reference	3.99 inches (24-hr, 100-yr, D.A.=55 mi.^{2}) NOAA Atlas II, Volume III, presented in Hydrologic Design Manual for Maricopa County, Arizona (FCDMC, 1991)
2.3.7	Unique Conditions and Problems	None
2.3.8	Coordination of Discharge Estimates	Peak flows reviewed by FCDMC & ADWR

Section 2.4: Hydraulics		
2.4.1	Model or Method Used HEC-1: Version 4.1 (July 1997) HEC-RAS Version 2.1 (Oct. 1997) Irregular Weir, Ohio DWR (1987)	<u>Ponding Areas</u>: • Irregular weir (broad-crested) program for embankment overtopping rating curves • AutoCAD/EaglePoint™ software interpolation of Digital Terrain Model for ponding volume estimates, • HEC-1 storage routing to estimate pool elevations in ponding areas <u>Flow Between Ponding Areas</u> • HEC-RAS for flow along SPRR and RID between adjacent ponding areas
2.4.2	Regime	Subcritical in ponding areas and conveyance reaches.
2.4.3	Frequencies for Which Flood Limits Computed	100-year
2.4.4	Method of Floodway Calculation	No floodway delineated
2.4.5	Unique Conditions and Problems	See special problem reports

Section 3.0: Survey & Mapping Information

3.1 Field Survey Information

Horizontal control survey was conducted in April of 1996 by Urban Engineering Inc.(UE), under the direct supervision of Louis P. DePrisco, R.L.S. In addition to surveying for horizontal control, UE also collected data for profiles of the canal and railroad. Appendix C contains copies of UE's field books and cross section tests results for this project. During the floodplain delineation work, additional surveys were required for the canal and railroad profile between 75th and 83rd Avenues. That survey was conducted under the direct supervision of Arthur A. Witzell, R.L.S., and the survey notes are contained at the end of Appendix A.

3.2 Mapping

Topographic mapping was provided to the District by Kenney Aerial Mapping Inc. at 1"=200' scale and with 2-foot contours. This mapping was based on survey data provided by Kaminski-Hubbard Engineers and Project Engineering Consultants Inc. Vertical elevations are based on the National Geodetic Vertical Datum of 1929. Horizontal control uses Arizona State Plane Coordinates based on the 1927 North American Datum. The flight date for the mapping was March 28, 1994.

Section 4.0: Hydrology

The primary purpose of the hydrologic analysis is to provide runoff data for delineation of flood hazard areas upstream from the SPRR and the RID Canal. Runoff is computed for the 100-year, 24-hour storm. The hydrology model is extended in the downstream direction beyond the SPRR and RID Canal to provide a complete model to the Salt River or Gila River on the south and the Agua Fria river on the west. The resulting model will be used as a tool for managing the development of the watershed.

4.1 Method Description

Hydrology for the Tolleson area is developed using the U.S. Army Corps of Engineers, *HEC-1 Flood Hydrograph Package* (HEC-1) computer program. Guidance is given in the *Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology* (DDM1) for application of the HEC-1 program within Maricopa County. Additionally, the computer program *Drainage Design Menu System* (DDMS) has been developed by the Flood Control District of Maricopa County to aid in the application of the methods described in DDM1. Features within the DDMS used for this study include *Computation of Precipitation Frequency-Duration Values in the Western United States* (PREFRE) and *Maricopa County Unit Hydrograph Procedure 2* (MCUHP2). The application of these tools is more specifically described in the companion volume *Floodplain Delineation of the Tolleson Area, Hydrology Report* and will not be repeated here.

Section 5.0: Hydraulics

5.1 Method Description

Two types of flood hazards along the upstream side of the embankments of the RID and the SPRR were studied by detailed methods for the Tolleson Area Floodplain Delineation Study: (1) ponding areas, and (2) riverine and/or sheet flow along the SPRR and RID between adjacent ponding areas. Storm water runoff in the study area generally flows toward the southwest, following the natural topography of the watershed. The RID and SPRR embankments are generally aligned east-west, creating obstructions to the southerly component of the natural runoff pattern. These obstructions divert the runoff to the west parallel to the RID and SPRR embankments. North-south aligned roadways, canal laterals, and other topographic features interrupt the diverted westerly component of flow along the embankments and create ponding areas. Within each subbasin upstream of the RID and SPRR, the depth of floodwater ponding is a function of the elevation of the RID and/or SPRR embankment on the south, the elevation of a roadway (or other type of) embankment to the west, the volume of floodwater delivered to the ponding area, and the rate of overflow for each embankment.

Different hydraulic modeling techniques are used for the two types of flood hazards. For ponding areas, flow hydraulics are modeled using an irregular weir rating program (ODWR, 1987) and HEC-1 (Version 4.1, July 1997) level-pool reservoir routing. Riverine and sheet flow between adjacent ponding areas is modeled using HEC-RAS (Version 2.1, October 1997).

The starting water surface elevation is discussed in Section 5.1.2 subsequently.

5.1.1 Ponding Areas. Much of the flooding in the study area occurs as the result of ponding upstream of the raised RID and SPRR embankments. The level-pool reservoir routing routine of HEC-1 (USCOE, 1990) is used to estimate ponding water surface elevations and to estimate flow rates between adjacent subbasins, based upon stage-storage-discharge data for each subbasin where ponding occurs. Stage-storage-discharge curves are developed in two basic steps:

(1) Estimation of stage-volume relationships from digital terrain models and detailed topographic mapping of the ponding areas.
(2) Estimation of stage-discharge relationships developed using detailed survey data and broad-crested weir flow equations for irregular weirs.

5.1.1.1 Stage-Volume Curves. Stage-volume curves for each subbasin are generated from the digital terrain model (DTM) provided by the FCDMC. The EaglePoint™ three-dimensional terrain modeling software package is used to estimate storage volumes for each reference contour within a potential ponding area for the areas of detailed ponding floodplain delineation.

5.1.1.2. Stage-Discharge Curves. Canal and railroad embankment overtopping was initially modeled as flow over irregular broad-crested weirs. Topographic data supplementing the FCDMC topographic mapping were obtained for each embankment profile from detailed field survey. For the RID canal, the top of the north and south canal embankments, and the top of the canal lining elevations were surveyed. The highest elevation for each surface surveyed was used to define the weir profile (control elevations). For the SPRR, the weir profile was defined by the highest top of rail elevation. For the north-south roadways, the centerline and curb elevations, or the highest continuous adjacent topographic feature was surveyed (e.g., an irrigation lateral) to define the overtopping weir profile.

The weir profiles are used in an irregular weir equation program developed by the U.S. Army Corps of Engineers (Ohio Dept. of Water Resources, 1987) to develop rating curves for each weir segment. Each ponding area typically has two controlling weirs:

(1) the east-west weir that controls runoff to the south (the RID or SPRR), and
(2) the north-south weir that controls runoff to the west.

These overtopping weir rating curves are then combined to generate the stage-discharge rating curve for the ponding area. The HEC-1 divert subroutine was used to split the overtopping flow to the south or west, according to the flow distribution determined for the overtopping weirs, as described in the hydrologic modeling section of this report.

5.1.2 Riverine Floodplains - Flow Between Adjacent Ponding Areas. The preliminary HEC-1 modeling results indicated that the ponding areas typically did not extend upstream to the next adjacent ponding area. HEC-1 routing further indicated that during the 100-year event, significant peak flows pass between adjacent ponding areas that would not be depicted by mapping only the ponding limits. Therefore, detailed mapping of the riverine and sheet flow between adjacent ponding areas is performed using the HEC-RAS model. Topographic data for HEC-RAS cross sections are obtained from the FCDMC digital terrain model using EaglePoint™ software. Supplemental ground elevation points, primarily for weirs or other hydraulic controls, are obtained from detailed field survey of the SPRR, RID, and roads conducted for this study or from the FCDMC topographic mapping.

The starting water surface elevation for the HEC-RAS profile is obtained from a storage routing at the ponding area adjacent to the Agua Fria flood control levee west of the El Mirage Avenue alignment performed by a private Study Contractor. The results of that storage routing is presented in Flood Insurance Rate Map Panel 2080, in a LOMR dated August 5, 1997. The starting water surface is at elevation 964.00.

5.1.3 Coordination of Hydrologic Analyses with Hydraulic Analyses. Initial HEC-RAS modeling results did not fully support the following assumptions made for the preliminary HEC-1 modeling at several of the ponding areas along the SPRR and RID:

- *Flow over the north-south drainage divides at the SPRR and RID ponding areas occurs as weir flow.* Flow over the north-south weir was found to be submerged, or controlled by backwater, at several of the ponding areas modeled by detailed methods.
- *Flow between adjacent ponding areas is contained by the SPRR and RID embankments.* HEC-RAS profiles indicated that overflow to the south occurs at several points between a few of the ponding areas modeled by detailed methods.

Therefore, to address these potential discrepancies, it was necessary to coordinate the results of the hydrologic analyses (HEC-1 modeling) with the hydraulic analyses (HEC-RAS and weir calculations) in several ways. Due to the interconnectedness of the HEC-1 and HEC-RAS models, it was necessary to iterate between the two models in a step-wise manner, from the upstream to downstream end of the study reach, to correctly estimate the 100-year discharge and account for storage and diversion losses at each node in the reaches studied by detailed method. The following iterative adjustments were made to the HEC-1 and HEC-RAS models.

First, weir calculations were used to establish the stage-storage-discharge relationships for each ponding area to be modeled in the preliminary HEC-1 models. Then, the outflow and diversion discharge rates estimated from the preliminary HEC-1 level pool routing through ponding areas were used for the preliminary HEC-RAS models. Second, where the HEC-RAS modeling indicated that the flow over the north-south roadways was submerged, the weir relationships used in the HEC-1 were replaced with rating curves based on HEC-RAS results. Then, the HEC-1 model was re-run to obtain revised discharge rates for use in the HEC-RAS models of the flow reaches between adjacent ponding areas. Where the HEC-RAS model indicated that flow over the weirs was not submerged, known water surface elevations based on the irregular weir calculations were entered into the HEC-RAS model. Third, where the HEC-RAS model indicated that the SPRR or RID could not contain flow along the embankment between the ponding areas (due to obstructions or lack of conveyance area), additional divert routines were added to the HEC-1 model to account for flow over the embankment between the ponding areas mapped by detailed methods.

Finally, for the purposes of floodplain delineation, where 100-year ponding elevations determined from the HEC-1 model are different than 100-year water surface profiles determined from the HEC-RAS model, the more conservative elevation is used.

5.2 Work Study Maps

Floodplain delineations based on HEC-1 and HEC-RAS modeling are shown on work study floodplain maps for the ponding and conveyance areas located along the SPRR and RID between 35th Avenue and theAgua Fria River near the El Mirage Avenue alignment (See Floodplain Delineation Maps). The 100-year ponding limits based primarily on HEC-1 modeling are shown for ponding areas along the upstream side of the RID between 35th Avenue and Interstate 10. The 100-year floodplain limits based on HEC-RAS modeling are depicted between 69th Avenue and

83rd Avenue along the RID, and between 69th Avenue and the Agua Fria River near the El Mirage Avenue alignment along the SPRR.

The downstream end of the modeling reach is located at the Agua Fria flood control levee west of the El Mirage Avenue alignment, and was designated River Mile 0.0. No continuous watercourse or defined flow path exists along the SPRR or RID modeling reach. Therefore, river mile stationing is based on the distance from River Mile 0.0 measured along the SPRR. In addition, channel cross section stationing is measured from the SPRR railroad grade, with the top of rail established as Station 5000.

No specific stream reaches are designated for the purposes of this study, although discharges and flow characteristics tended to vary at each cross section due to tributary inflows, diversions, obstructions, ponding, and impacts by development. Appendix G contains are reduced scale work maps showing cross section location, flow path alignment and 100-year floodplain limits.

5.3 Parameter Estimation

5.3.1 Roughness Coefficients. Manning's roughness coefficients, or "n" values, are determined using procedures adopted by the FCDMC. In addition, the following materials are used to support the analysis:

- Aerial Photographs: 1994 1:2,400 contact prints by Kenney Aerial Mapping, Inc. used for base mapping of study area.
- Ground Photographs: Color photographs taken during field reconnaissance trips.
- Field Data: Hydraulic information and geomorphic data gathered during field reconnaissance trips.

The typical FCDMC procedure consists of selection of a base "n" value and addition of several adjustment factors to determine a composite roughness coefficient for hydraulic modeling. The base "n" value accounts for roughness due to the bed material (Thomsen, 1991, Table 1). Adjustments to the base "n" value include factors for the degree of channel irregularity, obstructions, vegetation, variations in cross section geometry, and degree of meandering (Thomsen, 1991, Table 2). However, because the floodplains along the RID and SPRR are significantly different from typical riverine floodplains, an alternative methodology to select "n" values is used, as described below.

The 100-year flooding along the SPRR and RID to be modeled using HEC-RAS generally occurs as broad, unconfined, low-velocity runoff. Typical continuous riverine channels do not exist, and channel/overbank relationships probably do not apply within the HEC-RAS modeling reaches. Flow characteristics in these reaches may be more analogous to overbank flooding conditions than to channelized flow. Therefore, Manning's n values for the study reach reflect the land uses and cover types upstream of the SPRR and RID; and the FCDMC (Thomsen, 1991; Table 3) tables for floodplain "n" values are used to estimate Manning's n, as shown in Table 5.3.1.1 below.

Table 5.3.1.1. Tolleson Area Floodplain Delineation Study Typical "N" Values for HEC-RAS Modeling		
Description	**Average Value**	**Range**
Agricultural Areas		
Row Crops	0.035	0.025-0.045
Field Crops	0.040	0.030-0.050
Dense Trees & Brush	0.080	0.065-0.110
Vacant Land	0.030	0.025-0.035
Developed Areas		
Residential	0.075	0.024-0.150
Commercial/Industrial	0.080	0.024-0.150

In practice, "n" values were selected for each cross section based on features observed in the field and on the aerial photographs, using the typical values shown in Table 5.3.1.1 above. A composite "n" value is computed by the HEC-RAS model.

5.3.2 Expansion & Contraction Coefficients.

The default values of expansion and contraction coefficients, 0.1 and 0.3, respectively, are used in the HEC-RAS modeling. Significant and rapid changes in flow width occur in numerous places within the reaches mapped by detailed methods. However, rather than vary expansion and contraction coefficient in these low velocity zones and in ponding areas, ineffective flow boundaries are used to model flow expansion (4:1) and contraction (1:1) and to better simulate one-dimensional flow between ponding areas along the SPRR and RID.

5.4 Cross Section Description

HEC-RAS cross sections were spaced at 500 foot intervals, except where HEC-RAS rating curves were used to replace irregular weir ratings at the north-south control sections. In the latter locations, additional cross sections were added to the model immediately upstream and downstream of the north-south control feature to better model flow over the submerged obstruction. In general, cross sections are oriented north-south perpendicular to the SPRR and RID canal.

Due to the lack of a defined channel, the cross section "centerline" is located at the southernmost point of each cross section, at the SPRR or RID embankment. Cross section stationing is also controlled (Station = 5000) at the SPRR or RID embankment. Cross section data are obtained from the FCDMC digital terrain model using EaglePoint™ software, and are checked against the surveyed topographic data and the printed FCDMC topographic mapping for the study area.

5.5 Modeling Considerations

5.5.1 Hydraulic Jump and Drop Analysis. No hydraulic jumps were modeled in the study area. No drop structures exist in the areas mapped by detailed methods.

5.5.2 Bridges & Culverts. There are only four hydraulic structures that were identified within the floodplain delineation study limits. First, there is a 24-inch R.C.P. culvert with a headwall located just east of Evergreen Vegetable, Inc. west of 91st Avenue. This culvert is partially blocked with sediment, but appears to adequately convey small nuisance flows under the SPRR. Second, there are two 24-inch R.C.P. culverts located east of 107th Avenue south of an active agricultural area. Both of the latter two culverts are partially blocked with sediment and debris, and probably convey only a insignificant amount of flood flow under the SPRR. Third, there are 2-24" CSP under a newly constructed railroad spur located east of 107th Avenue. This spur was constructed between the time of the original field reconnaissance visits and the most recent field visits. Fourth, there are 2-24" CSP under a railroad spur located west of 83rd Avenue. No as-built plans for any of the culverts were available, as noted in the Data Collection Report. Due to the small diameter of the culverts, low capacity relative to the regulatory discharge, high potential for debris clogging, and orientation perpendicular to the modeled flow direction, the culverts are not included in the HEC-1 routing calculations or HEC-RAS profiles.

There are no hydraulic structures that convey flow under the RID canal, nor are there any bridges located in the areas mapped by detailed methods.

5.5.3 Levees & Dikes. Hydrologic and hydraulic modeling of the RID and SPRR embankments, as well as other structures oriented perpendicular to the primary flow direction is described in Section 5.1 above. No levees or dikes oriented parallel to flow were identified within the reaches modeled by detailed methods. The flood elevations shown on the floodplain maps are considered valid only if the canal and railroad embankments do not fail during a 100-year flood event.

5.5.4 Islands & Flow Splits. Flow splits, or diversions, occur at most subbasin locations along the SPRR and RID, as described in Section 5.1 above. Flow diverted at the SPRR and RID embankments between 75th Avenue and 83rd Avenue is modeled as an island using the HEC-RAS reach definition option. The 100-year discharge is distributed between the two parallel flow paths based on the conveyance distribution at the upstream cross section. The two flow paths rejoin after the flow branch north of the RID ponds at 83rd Avenue and is diverted to the south toward the SPRR ponding area. The "island" separating the two flow paths consists only of the RID canal embankments, which are perched above the 100-year water surface elevation for most of this reach.

5.5.5 Ineffective Flow Areas. Ineffective flow areas comprise a significant portion of the mapped floodplain. Several types of ineffective flow areas are defined. First, the ponding areas mapped using HEC-1 are essentially areas of ineffective flow, since runoff must back up and weir flow over the SPRR, RID, or the north-south road weir. Second, structures such as chain link fences, densely packed storage areas, or buildings create ineffective flow areas in both the upstream and downstream direction. In general, 4:1 expansion boundaries are used to define ineffective flow immediately downstream of obstructions, and 1:1 contraction boundaries are used immediately upstream of obstructions. Third, several excavated areas are modeled as ineffective for conveyance. These excavated areas included local retention basins and closed topographic depressions (natural or man-made), particularly low areas located away from the main flow area. The latter two types of ineffective flow are coded as blocked obstructions in the HEC-RAS model where they are not located at the floodplain margins.

5.5.6 Supercritical Flow. No supercritical flow occurs in the reaches mapped using detailed methods. Froude numbers computed by the HEC-RAS indicate that flow is strongly subcritical, except where flow crosses the north-south obstructions as weir flow or as weakly submerged weirs. No floodway was delineated. Therefore, the criteria established for State Standard 3-94 "State Standard for Supercritical Flow" does not apply.

5.5.7 Flow in Canals. The RID canal itself was not considered a hydraulic feature (i.e., conveyance of flood water within the canal) for purposes of HEC-1 or HEC-RAS modeling or floodplain delineation for several reasons. First, while the open channel portions of the RID canal appear to have some available freeboard and excess capacity during normal flow conditions, most of the roadway crossings (culverts and bridges) do not. Many roadway and laterals cross the RID canal with less than 0.5 foot of freeboard. Several crossings appear to act as flumes or have inlet headwater pools. Therefore, it was assumed that overflow into the canal would tend to pond rather than be effectively conveyed downstream in the canal. Second, flood overflow from the watershed into the canal would probably load the canal with debris and further reduce capacity at roadway and lateral crossings. Third, given the length of the downstream control weirs along the RID canal, the capacity available in the canal above the normal flow is minimal, as shown in Table 5.5.7.1. That is, the weir inflow rate into the canal, even at low head, would be greater than the conveyance capacity (outflow) of the canal given the limited capacity at the roadway crossings.

then reported on the floodplain maps using a large arrow and the words "Overflow Q=xxx cfs."

5.7.2 Modeling Warning & Error Messages.

Messages printed in the HEC-RAS output file include:
- critical depth warnings at north-south road crossings.
- vertical extensions at cross-section end points.

The critical depth warnings are normal for the flow conditions encountered in this study, and occur at roadways. The vertical cross-section extensions occur where runoff overtops the canal and flows to the railroad, and where runoff overtops the railroad and flows southerly.

5.8 Calibration

No known water surface elevations, historical flood records, or previous detailed studies are available from which to calibrate the hydraulic models or 100-year floodplain limits.

5.9 Final Results

5.9.1 Hydraulic Analysis Results.

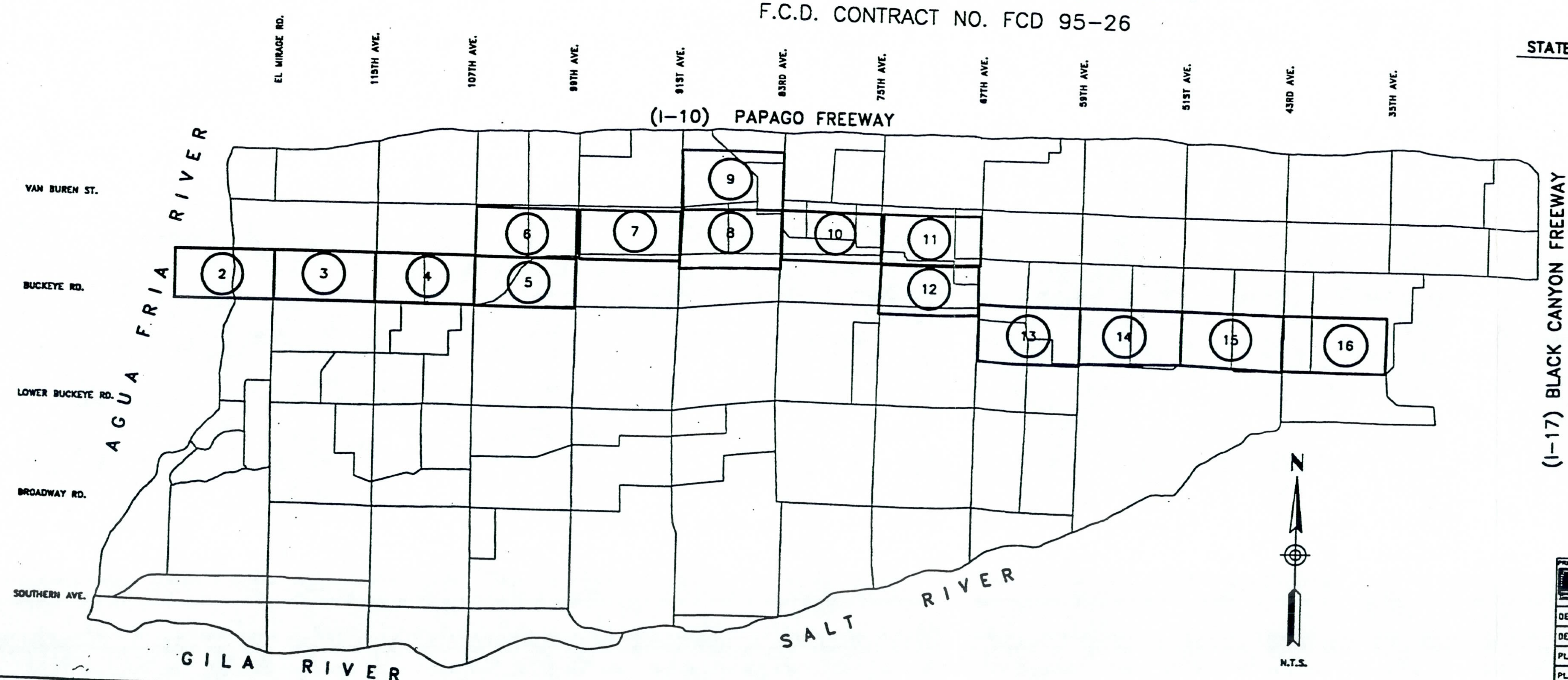
The table presented in Appendix E.3 summarizes the results of the hydraulic analyses, for the areas modeled in the HEC-RAS computer program. For the ponding areas, the results of the reservoir routing is contained in the HEC-1 summary table presented in the companion volume *Floodplain Delineation of the Tolleson Area, Hydrology Report.* The final water surface elevations for ponding areas are reported on floodplain delineation maps.

5.9.2 Verification of Results. Limited verification of results was possible by comparing the results of HEC-RAS modeling of north-south roadway overflow with the results of the irregular or uneven weir program. In general, the HEC-RAS results were within 0.5 foot of the uneven weir program results, well within the accuracy of the mapping used. Additional verification was achieved through the iterative modeling procedure used to coordinate HEC-1 and HEC-RAS results.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

TOLLESON AREA FLOODPLAIN DELINEATION

F.C.D. CONTRACT NO. FCD 95-26



LEGEND

100-yr FLOODPLAIN BOUNDARY
HYDRAULIC BASE LINE AND RIVER MILE
ELEVATION REFERENCE MARK
BASE FLOOD ELEVATION
ZONE AH ZONE DESIGNATION

CROSS SECTION DATA

RM– RIVER MILE STATION
WS– FLOODPLAIN WATER SURFACE ELEVATION
Q = 100-yr FLOW RATE IN CUBIC FEET PER SECOND (CFS)

NOTES

1. ALL ELEVATIONS ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929
2. ALL HORIZONTAL COORDINATES USE ARIZONA STATE PLANE COORDINATES BASED ON THE 1927 NORTH AMERICAN DATUM
3. RIVER MILE STATIONING BASED UPON HYDRAULIC BASELINE ALONG THE SOUTHERN PACIFIC RAILROAD.

STATEMENTS OF PROFESSIONAL REGISTRANTS

THE GROUND CONTROL SURVEY WAS PREPARED UNDER MY DIRECT SUPERVISION:

THE HYDROLOGIC VALUES USED FOR THE FLOODPLAIN DELINEATION, AS WELL AS THE FLOODPLAIN DELINEATION WERE PREPARED UNDER MY DIRECT SUPERVISION:

21684 BRIAN J. FRY ARIZONA, U.S.A.

FLOWN BY:
KENNEY AERIAL MAPPING INC.
FLIGHT DATE MARCH 28,1994

PRIME CONSULTANT: DIBBLE & ASSOCIATES CONSULTING ENGINEERS			SUB CONSULTANT: JE Fuller Hydrology & Geomorphology, Inc.
DESIGN	BY DCF	DATE 01/99	FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
DESIGN CHK.	BJF	01/99	RECOMMENDED BY: DATE
PLANS	PAF/JEV	01/99	APPROVED BY: DATE
PLANS CHK.	BJF	01/99	CHIEF ENGINEER AND GENERAL MANAGER
SUBMITTED BY: DATE			SHEET 1 of 16

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

TOLLESON AREA FLOODPLAIN DELINEATION
"FCD CONTRACT # 95-26"

LEGEND

- BUILDING
- SINGLE RESIDENTIAL BUILDING
- ROAD/PAVEMENT
- DIRT ROAD
- HIDDEN ROAD/HIDDEN PAVEMENT
- CURB
- HIDDEN CURB
- RAILROAD
- INDEX CONTOUR
- DEPRESSED INDEX CONTOUR
- INTERMEDIATE CONTOUR
- DEPRESSED INTERMEDIATE CONTOUR
- WASH/ DRAINAGE/WATERLINE
- IRRIGATION DITCH
- TREE LINE
- SPOT ELEVATION
- HORIZONTAL & VERTICAL CONTROL POINT
- VERTICAL CONTROL POINT

ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
BM-2	968.94	BCHH El Mirage & Buckeye.

INDEX MAP

0 200' 400' 600'
SCALE: 1" = 200'
CONTOUR INTERVAL = 2 FEET

PRIME CONSULTANT: DIBBLE & ASSOCIATES CONSULTING ENGINEERS

SUB CONSULTANT: JE Fuller Hydrology & Geomorphology, Inc.

	BY	DATE
DESIGN	DCF	01/99
DESIGN CHK.	BJF	01/99
PLANS	PAF/JEV	01/99
PLANS CHK.	BJF	01/99

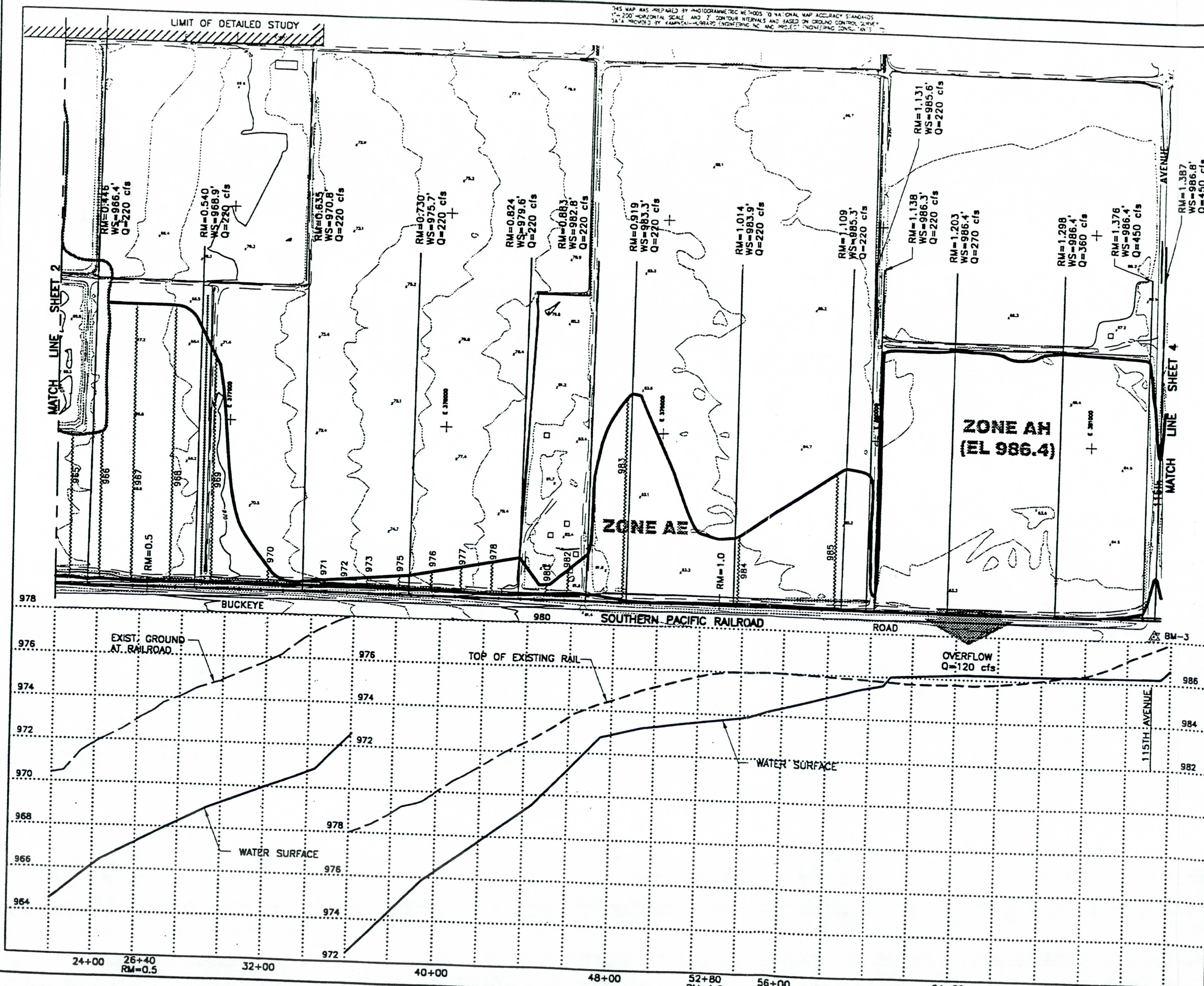
SUBMITTED BY: ______ DATE

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: ______ DATE

APPROVED BY: ______ DATE

CHIEF ENGINEER AND GENERAL MANAGER



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

TOLLESON AREA FLOODPLAIN DELINEATION "FCD CONTRACT # 95-26"

LEGEND

- BUILDING
- SINGLE RESIDENTIAL BUILDING
- ROAD/PAVEMENT
- DIRT ROAD
- HIDDEN ROAD/HIDDEN PAVEMENT
- CURB
- HIDDEN CURB
- RAILROAD
- INDEX CONTOUR
- DEPRESSED INDEX CONTOUR
- INTERMEDIATE CONTOUR
- DEPRESSED INTERMEDIATE CONTOUR
- WASH/ DRAINAGE/WATERLINE
- IRRIGATION DITCH
- TREE LINE
- SPOT ELEVATION
- HORIZONTAL & VERTICAL CONTROL POINT
- VERTICAL CONTROL POINT

ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
BM-3	987.09	BCHH 115 Ave. & Buckeye Rd.

INDEX MAP

SCALE: 1" = 200'
CONTOUR INTERVAL = 2 FEET

PRIME CONSULTANT: DIBBLE & ASSOCIATES CONSULTING ENGINEERS

SUB CONSULTANT: JE Fuller Hydrology & Geomorphology, Inc.

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DESIGN	DCF	01/99
DESIGN CHK.	BJF	01/99
PLANS	PAF/JEV	01/99
PLANS CHK.	BJF	01/99

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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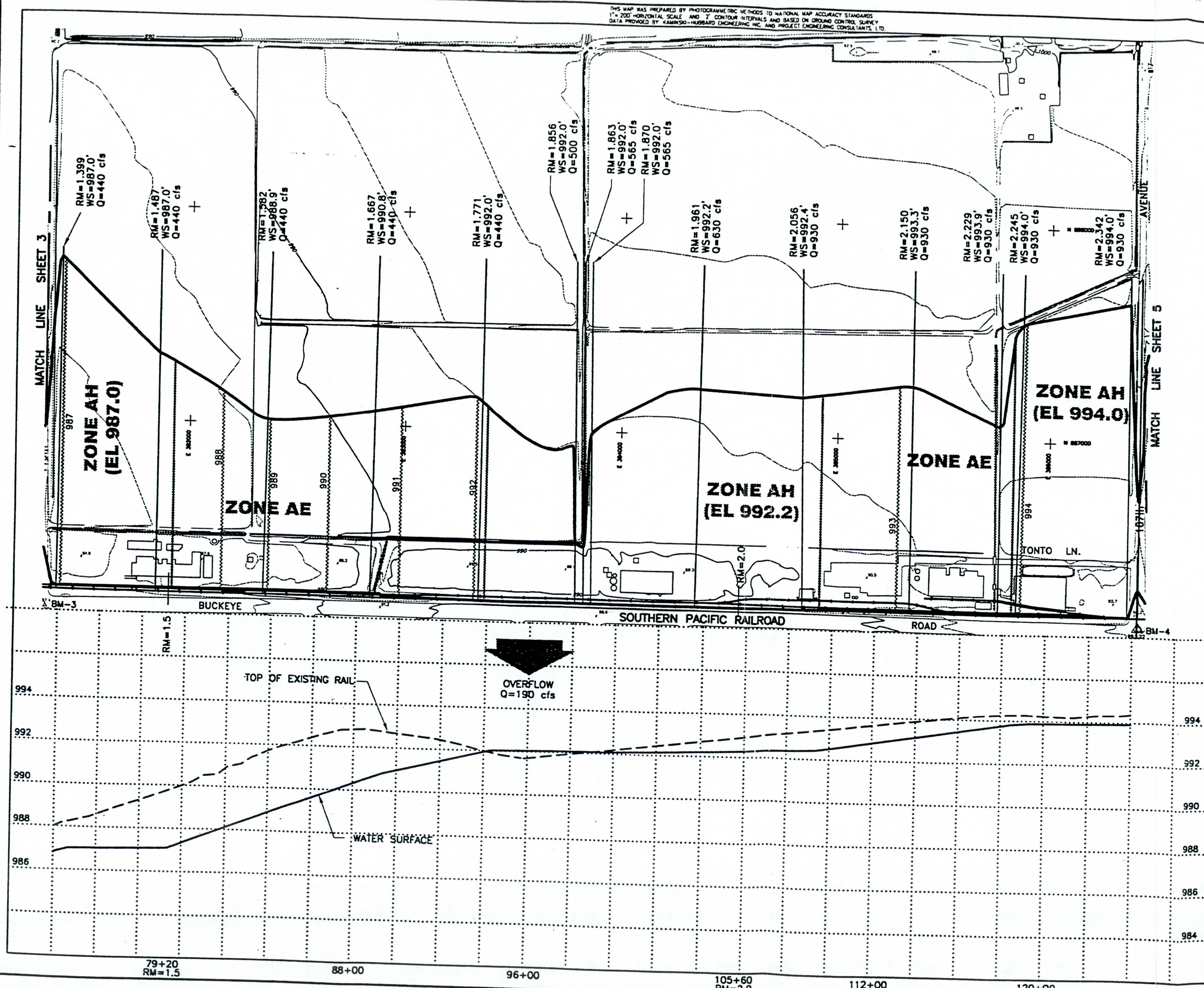
SHEET 3 OF 16



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

TOLLESON AREA FLOODPLAIN DELINEATION "FCD CONTRACT # 95-26"

LEGEND

- BUILDING
- SINGLE RESIDENTIAL BUILDING
- ROAD/PAVEMENT
- DIRT ROAD
- HIDDEN ROAD/HIDDEN PAVEMENT
- CURB
- HIDDEN CURB
- RAILROAD
- INDEX CONTOUR
- DEPRESSED INDEX CONTOUR
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ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
BM-3	987.09	BCHH 115 Ave. & Buckeye Rd.
BM-4	993.22	BCHH 107th Ave. & Buckeye Rd.

INDEX MAP

21684 BRIAN J. FRY ARIZONA, U.S.A.

0 200' 400' 600'

SCALE: 1" = 200'

CONTOUR INTERVAL = 2 FEET

PRIME CONSULTANT: DIBBLE & ASSOCIATES CONSULTING ENGINEERS

SUB CONSULTANT: JE Fuller Hydrology & Geomorphology, Inc.

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DESIGN CHK.	BJF	05/99
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PLANS CHK.	BJF	05/99

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SHEET 4 OF 16

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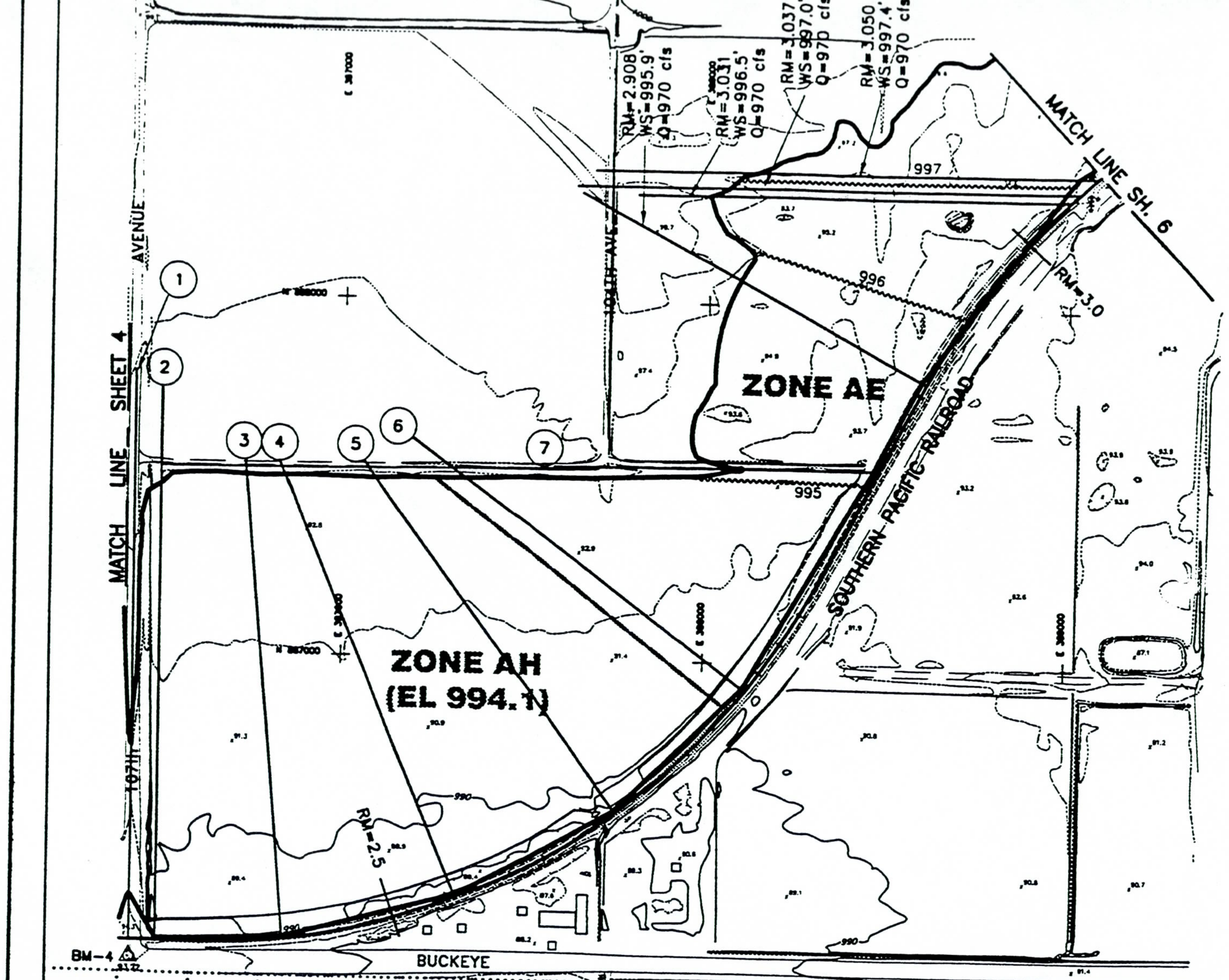

SECTION	RM	WS	Q (cfs)
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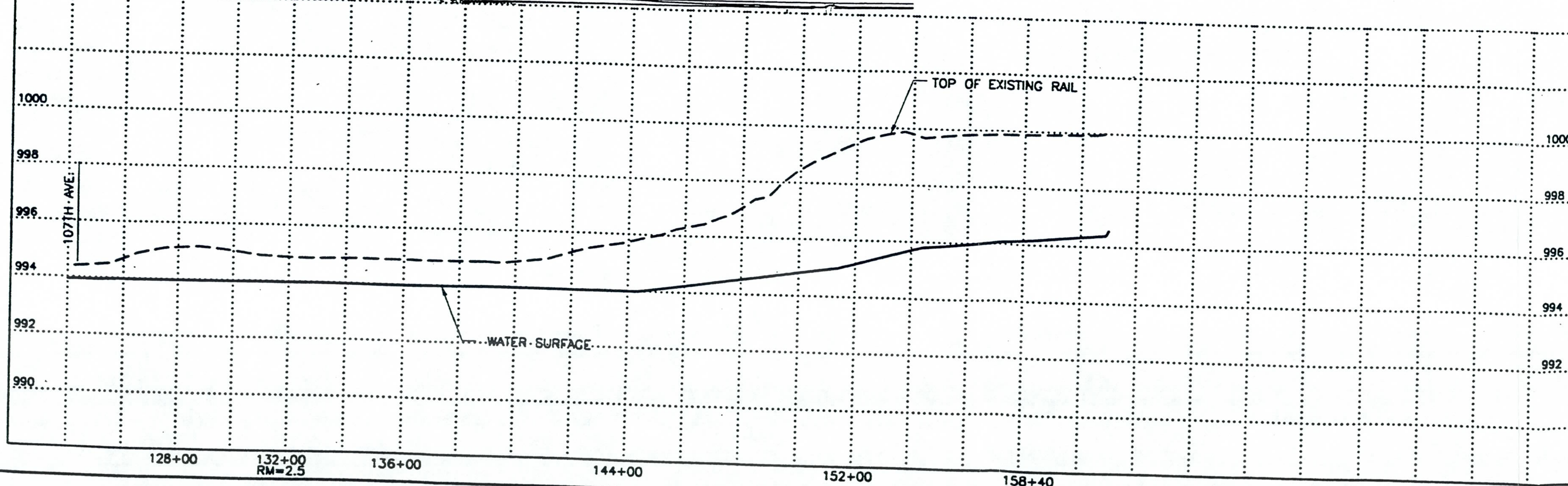
2	2.366	994.1'	970
3	2.434	994.1'	970
4	2.529	994.1'	970
5	2.624	994.1'	970
6	2.718	994.1'	970
7	2.851	995.1'	970



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

TOLLESON AREA FLOODPLAIN DELINEATION
"FCD CONTRACT # 95-26"

LEGEND

- BUILDING
- SINGLE RESIDENTIAL BUILDING
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- HIDDEN CURB
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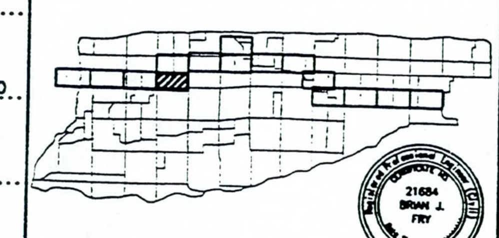
- VERTICAL CONTROL POINT

ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
BM-4	993.22	BCHH 107 Ave. & Buckeye Rd.

INDEX MAP



SCALE: 1" = 200'
CONTOUR INTERVAL = 2 FEET

PRIME CONSULTANT: DIBBLE & ASSOCIATES CONSULTING ENGINEERS

SUB CONSULTANT: JE Fuller Hydrology & Geomorphology, Inc.

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PLANS	PAF/JEV	05/99
PLANS CHK.	BJF	05/99

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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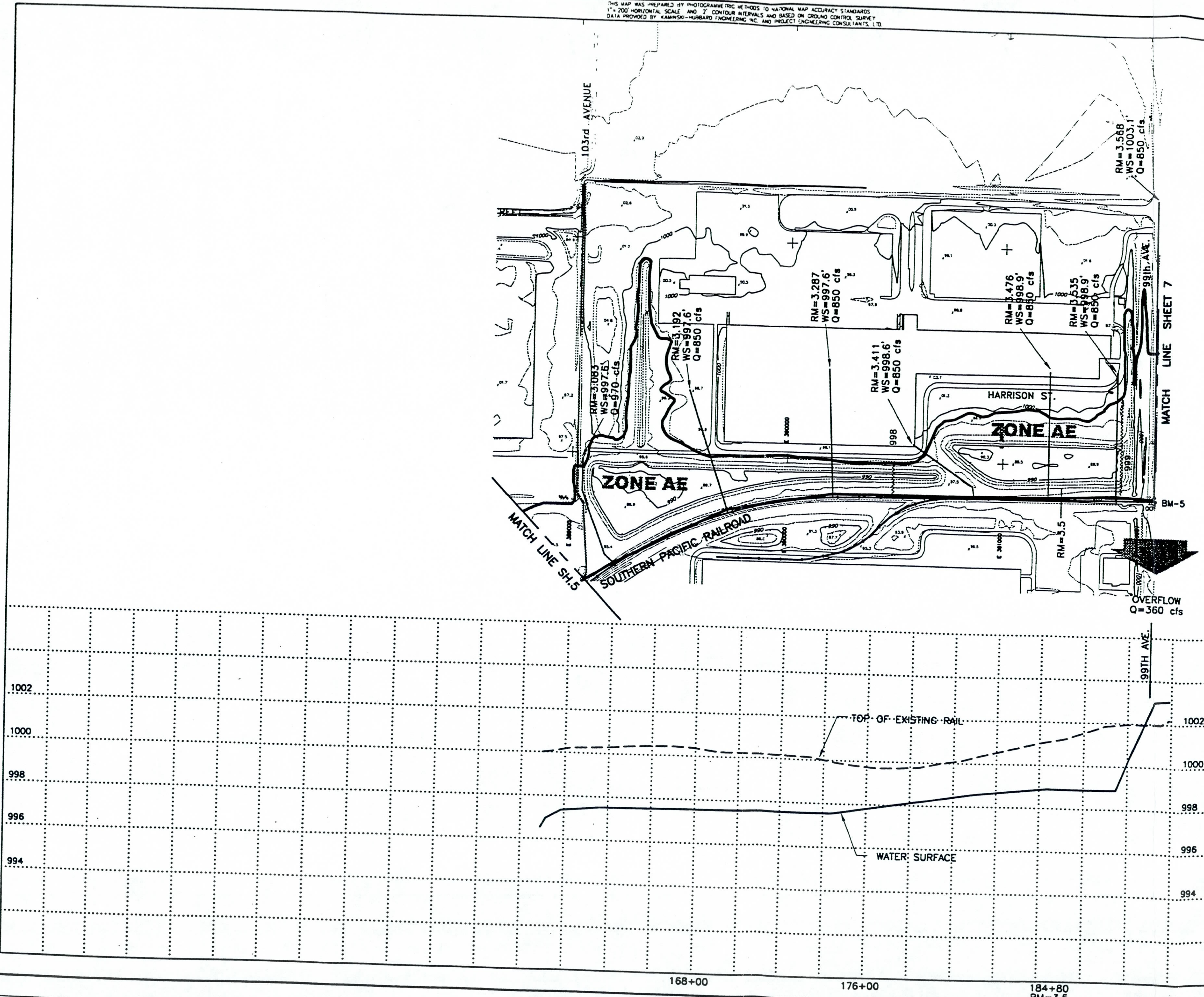
CHIEF ENGINEER AND GENERAL MANAGER

SHEET 5 OF 16



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

TOLLESON AREA FLOODPLAIN DELINEATION

"FCD CONTRACT # 95-26"

LEGEND

BUILDING
SINGLE RESIDENTIAL BUILDING
ROAD/PAVEMENT
DIRT ROAD
HIDDEN ROAD/HIDDEN PAVEMENT
CURB
HIDDEN CURB
RAILROAD
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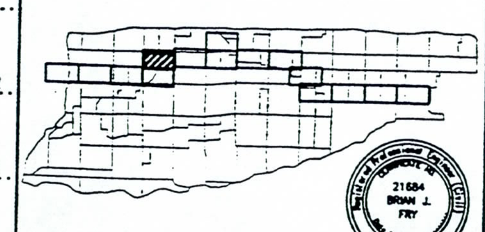
ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
BM-5	1001.80	BCHH 99th Ave. & R.R. Crossing, East 1/4 Sec. 8.

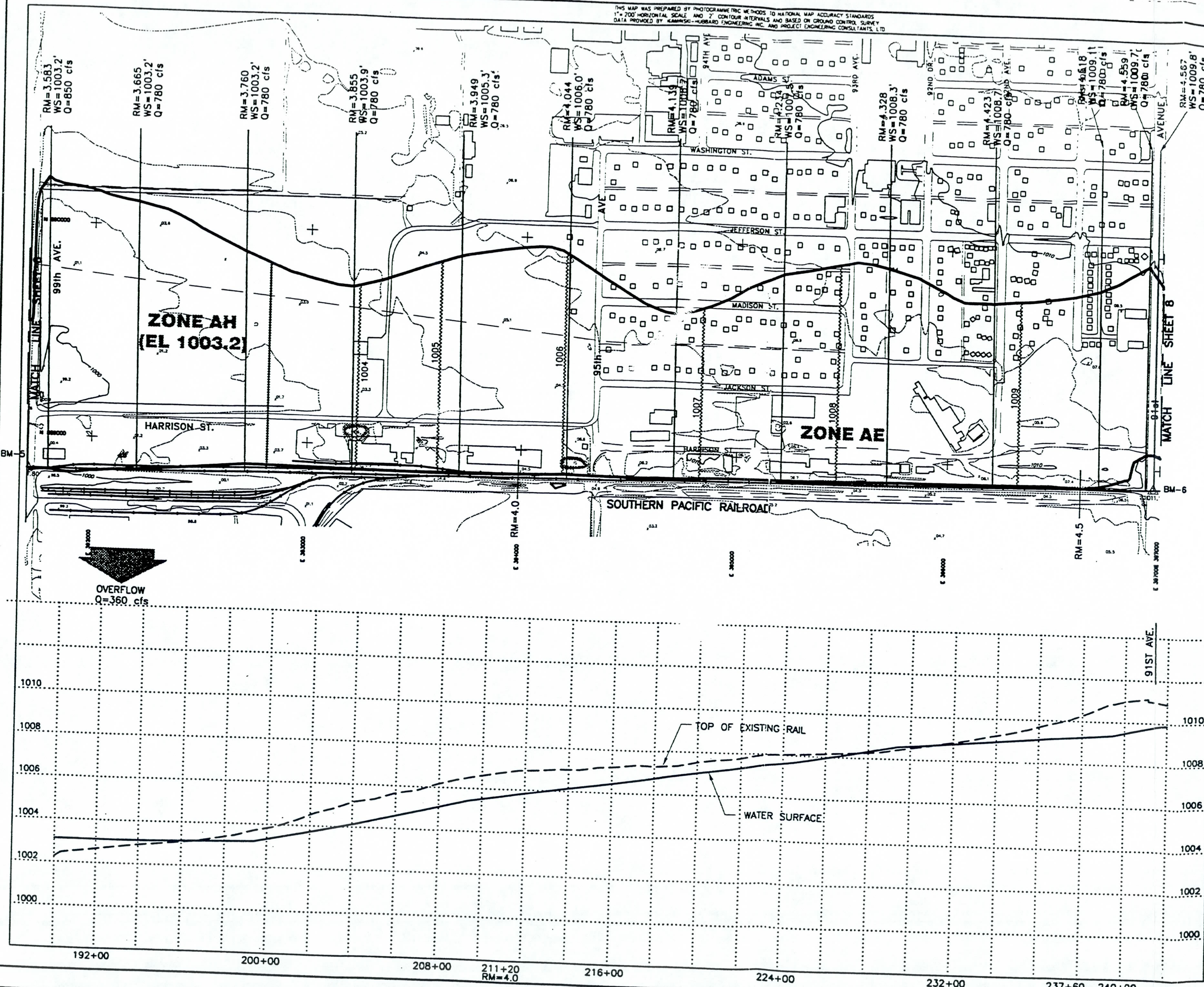
INDEX MAP



N

0 200' 400' 600'
SCALE: 1" = 200'
CONTOUR INTERVAL = 2 FEET

PRIME CONSULTANT: DIBBLE & ASSOCIATES CONSULTING ENGINEERS			SUB CONSULTANT: JE Fuller Hydrology & Geomorphology, Inc.
DESIGN	BY DCF	DATE 05/99	FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
DESIGN CHK.	BJF	05/99	RECOMMENDED BY: DATE
PLANS	PAF/JEV	05/99	APPROVED BY: DATE
PLANS CHK.	BJF	05/99	CHIEF ENGINEER AND GENERAL MANAGER
SUBMITTED BY: DATE			SHEET 6 of 16



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

TOLLESON AREA FLOODPLAIN DELINEATION
"FCD CONTRACT # 95-26"

LEGEND

- BUILDING
- SINGLE RESIDENTIAL BUILDING
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ELEVATION REFERENCE MARKS

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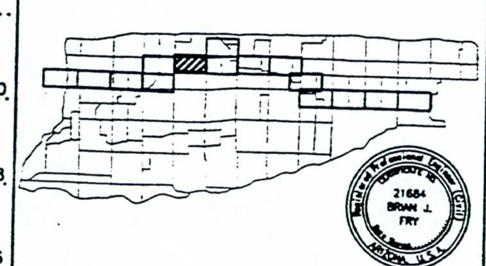
I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
BM-5	1001.80	BCHH 99th Ave. & R.R. Crossing, East 1/4 Sec. 8.
BM-6	1011.11	BCHH 91st Ave. & R.R. Crossing, East 1/4 Sec. 9.

INDEX MAP



0 200' 400' 600'
SCALE: 1" = 200'
CONTOUR INTERVAL = 2 FEET

PRIME CONSULTANT: DIBBLE & ASSOCIATES CONSULTING ENGINEERS

SUB CONSULTANT: JE Fuller Hydrology & Geomorphology, Inc.

	BY	DATE
DESIGN	DCF	05/99
DESIGN CHK.	BJF	05/99
PLANS	PAF/JEV	05/99
PLANS CHK.	BJF	05/99

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CHIEF ENGINEER AND GENERAL MANAGER

SHEET 7 OF 16

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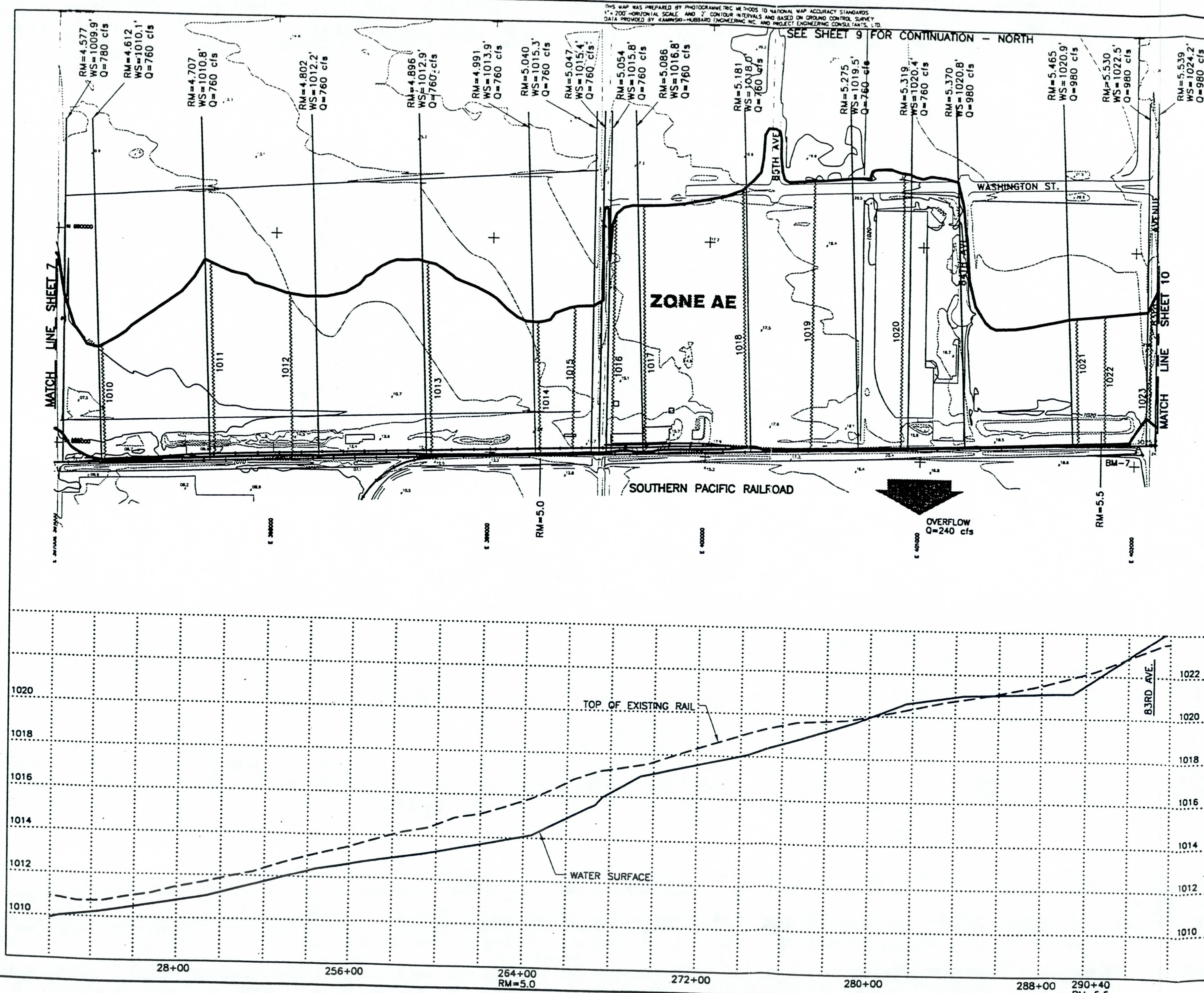

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

TOLLESON AREA FLOODPLAIN DELINEATION

"FCD CONTRACT # 95-26"

LEGEND

BUILDING
SINGLE RESIDENTIAL BUILDING
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ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
BM-7	1025.79	Alum. Cap on Irr. Box South Side Center, West Side of 83rd Ave. At Railroad Xing.

INDEX MAP

SCALE: 1" = 200'
CONTOUR INTERVAL = 2 FEET

PRIME CONSULTANT: DIBBLE & ASSOCIATES CONSULTING ENGINEERS
SUB CONSULTANT: JE Fuller Hydrology & Geomorphology, Inc.

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PLANS	PAF/JEV	05/99	APPROVED BY / DATE
PLANS CHK.	BJF	05/99	CHIEF ENGINEER AND GENERAL MANAGER
SUBMITTED BY: / DATE			SHEET 8 of 16

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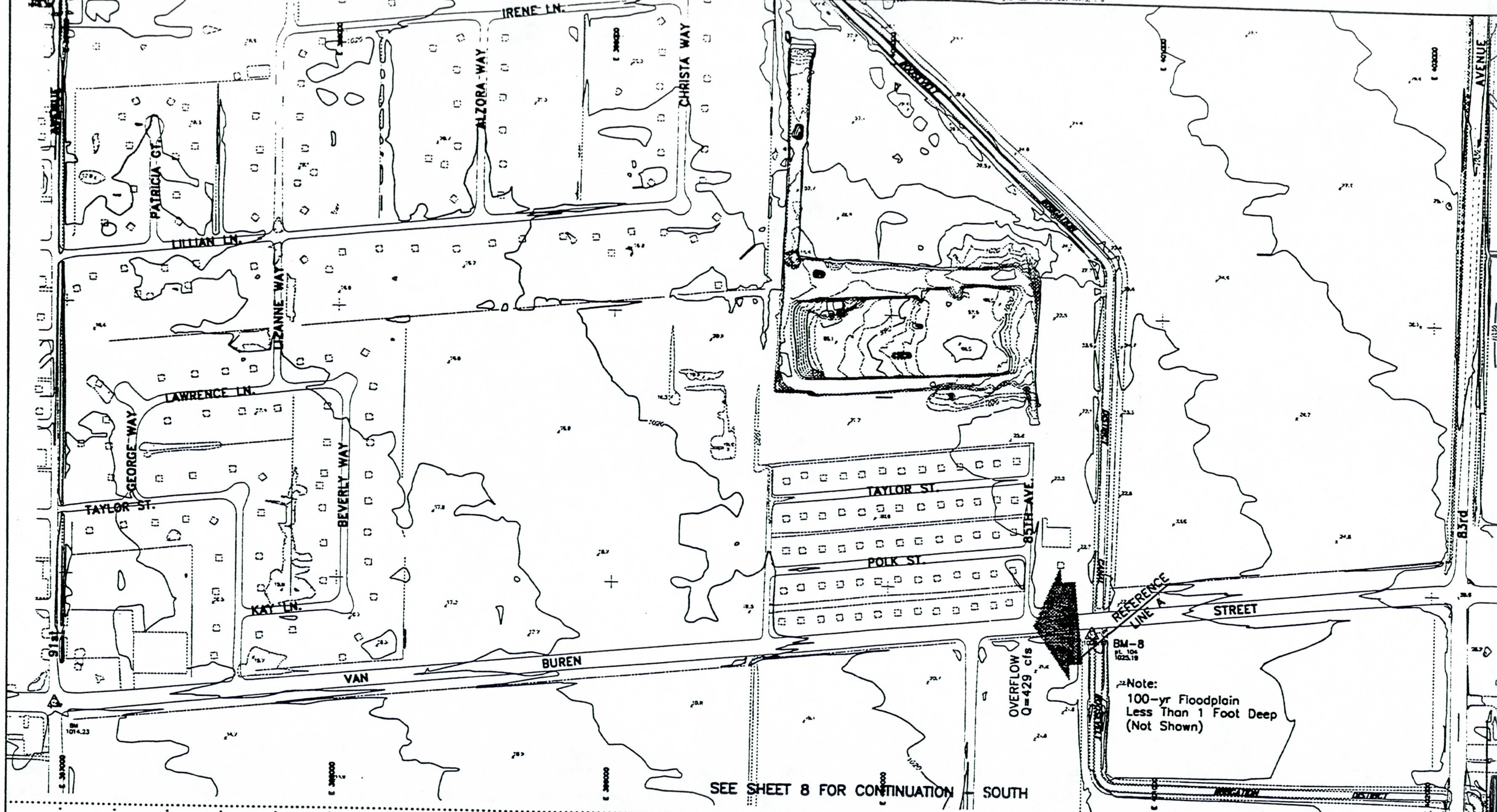
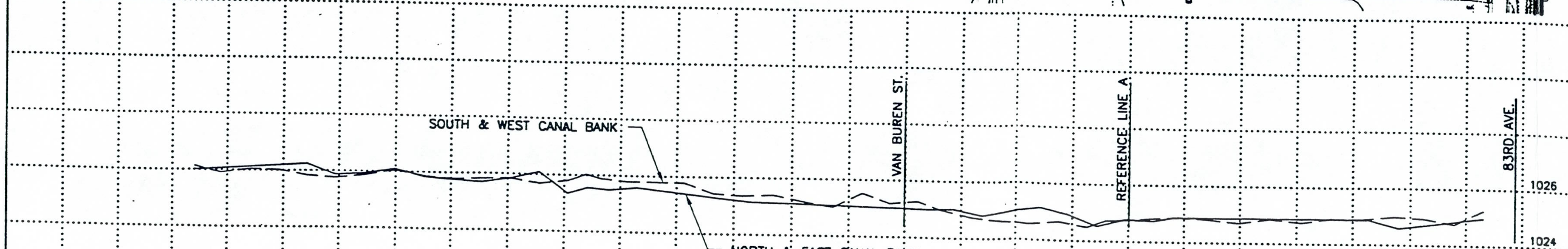


SEE SHEET 8 FOR CONTINUATION — SOUTH



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

TOLLESON AREA FLOODPLAIN DELINEATION

"FCD CONTRACT # 95-26"

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ELEVATION REFERENCE MARKS

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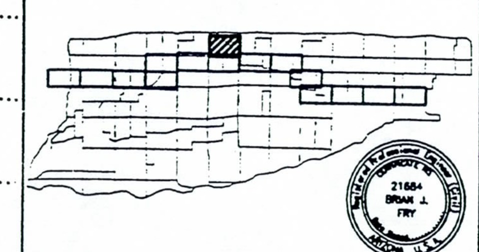
I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
BM-8	1025.19	B.C. Top HDWL South Side of Van Buren at R.I.D. Canal & East of 85th Ave.

INDEX MAP



0 200' 400' 600'

SCALE: 1" = 200'

CONTOUR INTERVAL = 2 FEET

PRIME CONSULTANT: DIBBLE & ASSOCIATES CONSULTING ENGINEERS

SUB CONSULTANT: JE Fuller Hydrology & Geomorphology, Inc.

	BY	DATE
DESIGN	DCF	05/99
DESIGN CHK.	BJF	05/99
PLANS	PAF/JEV	05/99
PLANS CHK.	BJF	05/99

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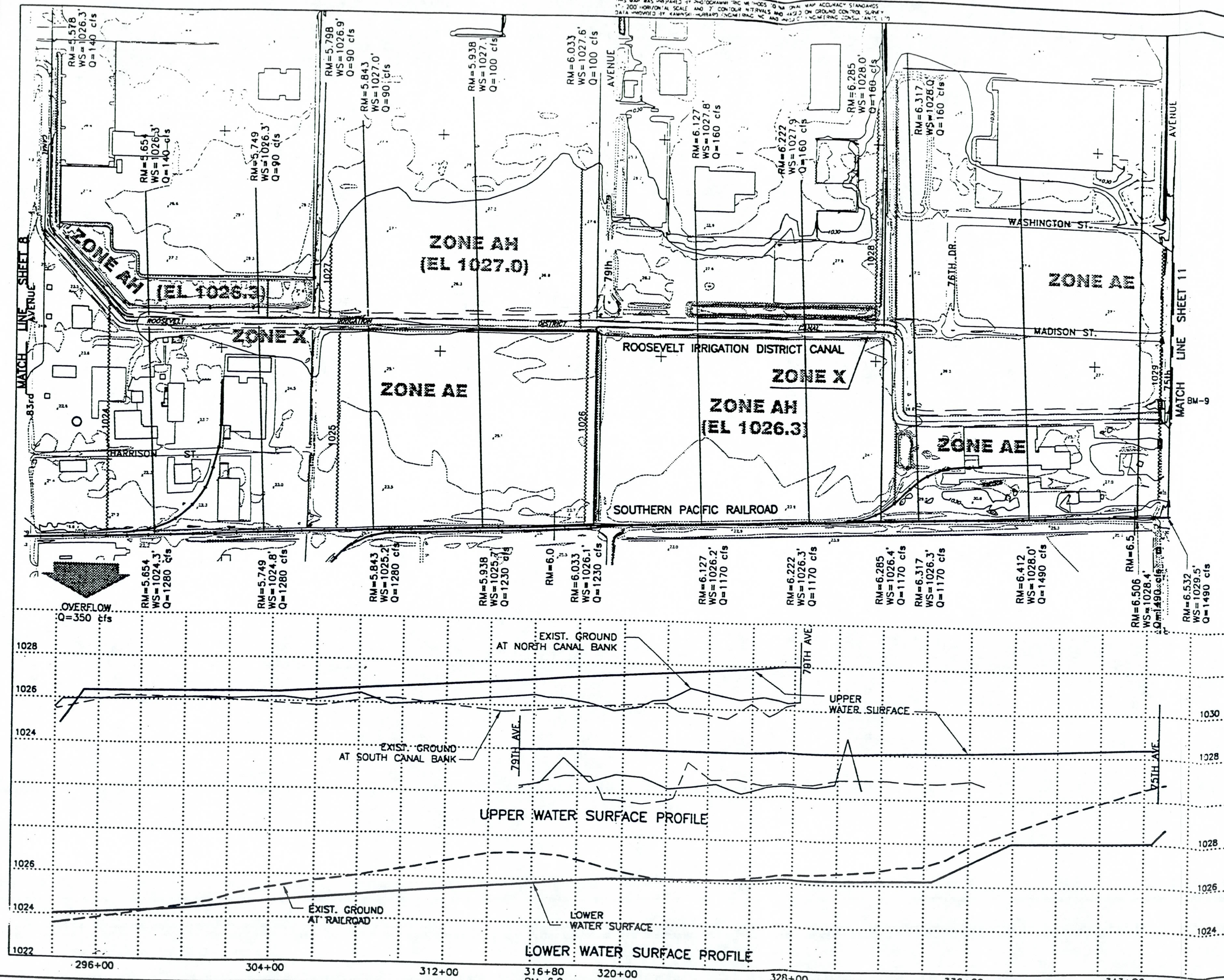
SHEET 9 of 16



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

TOLLESON AREA FLOODPLAIN DELINEATION "FCD CONTRACT # 95-26"

LEGEND

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ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
BM-9	1029.71	Maricopa Co. Brass Cap 75th Ave. Bridge At R.I.D. Canal NE Wing Wall.

INDEX MAP

0 200' 400' 600'
SCALE: 1" = 200'
CONTOUR INTERVAL = 2 FEET

DIBBLE & ASSOCIATES CONSULTING ENGINEERS

JE Fuller Hydrology & Geomorphology, Inc.

	BY	DATE
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PLANS	PAF/JEV	01/99
PLANS CHK.	BJF	01/99
SUBMITTED BY:		

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

SHEET 10 of 16

APPENDIX E-5: Excerpts from Floodplain Delineation of the Tolleson Area – Field Reconnaissance Report

Floodplain Delineation of Tolleson Area

Field Reconnaissance Report

Prepared for

Flood Control District
of
Maricopa County

Prepared by:

Dibble & Associates Consulting Engineers
2633 E. Indian School Rd., Suite 401
Phoenix, AZ 85016-6763
602-957-1155

JE Fuller/ Hydrology & Geomorphology, Inc.
583 W. Magdalena Dr.
Tempe, AZ 85283
602-752-2124

Registered Professional Engineer (Civil)
CERTIFICATE NO
26346
JONATHAN E.
FULLER
Date Signed 10-16-97

October 1997
(Revised)

Introduction

This report summarizes the results of the field reconnaissance for the Tolleson Area Floodplain Delineation Study (FDS). The purpose of this report is to:

- Document field conditions relevant to floodplain modeling
- Document the proposed locations of ponding area control weirs
- Document the methodology used to select Manning's N values

This report is the deliverable for Tasks 6.6a and 6.7 of Flood Control District of Maricopa County (FCDMC) contract number FCD 95-26, Change Order #2 (July 15, 1997).

Study Limits

The Tolleson Area FDS study limits include approximately 15 total linear miles of floodplain delineation. Six miles of the delineation area are located along the Southern Pacific Railroad (SPRR) between 83rd Avenue and the Agua Fria River west of El Mirage Road (Figure 1). The remainder of the delineation area is located along the Roosevelt Irrigation District (RID) canal between 35th Avenue and Interstate 10. Ponding areas in the later two reaches were modeled using HEC-1 routing. Two portions of the study area, from 67th Avenue to 83rd Avenue along the RID/SPRR, and from 75th Avenue to El Mirage Road along the SPRR were modeled using HEC-RAS. The study area is generally located in Township 1 North, Range 1 East (T1N, R1E) and Township 1 North, Range 2 East (T1N, R2E). The Tolleson Area Floodplain Delineation study area includes reaches of ponded urban and agricultural runoff, as well as riverine-like flow upstream of, and parallel to, the SPRR and RID.

Field Reconnaissance Objectives

The project team conducted initial field reconnaissance visits to the study area on March 26, 1996, April 10, 1996, and September 17, 1997. Additional site-specific field visits by individual members of the project team at other times between March 1996 and October 1997. The overall goal of field reconnaissance was to become familiar with the study area prior to floodplain modeling. Specific goals of field reconnaissance included the following:

- Identify hydraulic controls and flow obstructions for probable ponding areas
- Document the proposed locations of ponding area control weirs
- Identify the locations of culverts and other hydraulic structures
- Identify topographic and hydraulic features to be surveyed by the survey subconsultant
- Observe ponding areas, critical watershed points and flooding problem areas
- Obtain photographic documentation of watershed and floodplain conditions
- Obtain photographic documentation for use in estimating Manning's N values

This report documents the results of the field reconnaissance for the Tolleson FDS.

Watershed Description

The study area watershed is located in central Maricopa County, and includes areas within the cities of Phoenix, Tolleson, and Avondale, as well as small portions of unincorporated Maricopa County. The watershed limits are defined by Interstate 10 (I-10) to the north, 35th Avenue to the east, the Agua Fria River to the west, and the Salt River to the south. For the purposes of this study, no runoff from north of I-10 was assumed to enter the study area.

The watershed, which was subject to sheet flow and poorly-defined distributary flow prior to development, slopes gently to the southwest toward the Salt and Gila Rivers at a slope of about 0.3 percent (18 ft/mi). Past and current agricultural use, as well as more recent urbanization, have obscured most remnants of the natural drainage pattern in the watershed. In existing conditions storm water runoff flows in streets, along irrigation canal berms and laterals, or as urban and agricultural sheet flow. Because engineered and/or 100-year drainage facilities generally are lacking in the watershed and because most runoff is unconfined, storm water tends to pond upstream of several types of flow obstructions. Obstructions that may cause local ponding areas include irrigation canals, flood irrigation berms, railroad grades, roads, block walls, fences, buildings, and natural topographic features.

Reach Definition

Two types of reaches were defined for the Tolleson Area FDS: (1) ponding reaches, and (2) riverine-like floodplain reaches. Two main obstructions cause ponding within the study area - the RID canal and the SPRR grade. The RID flows due west from 35th Avenue to about 59th Avenue, before turning to the northwest along an irregular alignment until it passes under I-10 and leaves the study area. The SPRR crosses the study area along an east-west alignment from I-17 to the Agua Fria River. Ponding area reaches mapped using detailed methods for this study include the area upstream of the RID canal between 35th Avenue and I-10, and the area upstream of the SPRR between 83rd Avenue and the Agua Fria River. Local ponding areas east of 83rd Avenue along the SPRR were identified for hydrologic modeling purposes, but were not mapped as part of this study. The two main ponding reaches along the SPRR and RID were further subdivided based on the features that provide hydraulic control of ponded water, as described below. Ponding subreaches are shown in Table 1 and Figure 2.

Riverine-type floodplains also occur in the study area. These floodplains are not defined rivers or streams, but consist of unconfined flow between adjacent ponding areas. These riverine-type floodplains occur where storm water runoff flows over the hydraulic control from one ponding area, and flows parallel to the SPRR or the RID, and enters the next downstream ponding area. These floodplains were modeled using the HEC-RAS hydraulic model along the SPRR/RID alignment from 67th Avenue to 83rd Avenue, and along the SPRR alignment from 75th Avenue to the El Mirage Road alignment. The same reach designations shown in Table 1 and Figure 2 were used for both ponding and riverine-type floodplains.

Table 1. Tolleson Area FDS - Reach Limits and Reach Type

Ponding Reach	Subreach	East Limit	West Limit	Ponding	Riverine
RID	QE	35th Ave.	41st Ave.[1]	x	
RID	QD	41st Ave.[1]	43rd Ave.	x	
RID	QB	43rd Ave.	47th Ave.[1]	x	
RID	QA	47th Ave.[1]	51st Ave.	x	
RID	PF	51st Ave.	55th Ave.	x	
RID	PE	55th Ave.	59th Ave.	x	
RID	PD	59th Ave.	63rd Ave.[1]	x	
RID	PC	63rd Ave.[1]	67th Ave.	x	
RID	UE	67th Ave.	69th Ave.[1]	x	x
RID[2]	SF	69th Ave.[1]	75th Ave.	x	x
RID[2]	SH	75th Ave.	77th Ave.[1]	x	x
RID[2]	SG	77th Ave.[1]	81st Ave.[1]	x	x
RID[2]	SE	81st Ave.[1]	83rd Ave.	x	x
RID[2]	SD	83rd Ave.	RID/85th Ave.[1]	x	
RID	SB	85th Ave.[1]	RID/I-10	x	
SPRR	RI	83rd Ave.	87th Ave.[1]	x	x
SPRR	RH	87th Ave.[1]	91st Ave.	x	x
SPRR	OG	91st Ave.	99th Ave.	x	x
SPRR	OF	99th Ave.	103rd Ave.[1]	x	x
SPRR	OB	103rd Ave.[1]	107th Ave.	x	x
SPRR	LE	107th Ave.	111th Ave.	x	x
SPRR	KD	111th Ave.	115th Ave.	x	x
SPRR	KA	115th Ave.	El Mirage Ave[1]	x	x

Notes:
[1] Alignment only
[2] Downstream control of RID ponding area probably provided by SPRR grade

Ponding Area Hydraulic Controls

Hydraulic control of the ponding areas upstream of the RID canal and the SPRR alignment is generally provided by topographic and man-made features that may be modeled as broad-crested weirs. The main types of topographic and man-made features to be modeled as weirs for the FDS include the following:

- Access road grades (south or north side) along the RID
- Top of gunite/concrete lining of the RID canal
- Berms along irrigation laterals
- Top of rail along the SPRR grade or spur grades
- Roadway centerline crown or top of curb

Access Roads. Access roads are located along the north and/or south sides of the RID canal. These dirt roads generally provide the downstream hydraulic control for ponding areas located upstream of the RID canal. Routine maintenance of the RID canal and access roads often leaves a small, uneven earthen "wind-row" berm between the access road and the canal. Use of the top of the wind-row berm for the weir crest elevation could raise the visits and the most recent field visits. Fourth, there are 2-24" CSP under a railroad spur located west of 83rd Avenue. No as-built plans for any of the three culverts were available, as noted in the Data Collection Report. Due to the small diameter of the culverts, low capacity, and high potential for debris clogging, the culverts were not included in the HEC-1 routing calculations for the ponding storage areas. There are no hydraulic structures that convey flow under the RID canal.

The RID canal itself was not considered a hydraulic feature (i.e., conveyance of flood water within the canal) for purposes of HEC-1 modeling or floodplain delineation for several reasons. First, while the open channel portions of the RID canal appear to have some available freeboard and excess capacity during normal flow conditions, most of the roadway crossings (culverts and bridges) do not. Many roadway and laterals cross the RID canal with less than 0.5 foot of freeboard. Several crossings appear to act as flumes or have inlet headwater pools. Therefore, it was assumed that overflow into the canal would tend to pond rather than be effectively conveyed downstream in the canal.[5] Second, flood overflow from the watershed into the canal would probably load the canal with debris and further reduce capacity at roadway and lateral crossings. Third, given the length of the downstream control weirs along the RID canal, the capacity available in the canal above the normal flow is minimal, as shown in Table 2. That is, the weir inflow rate into the canal, even at low head, would be greater than the conveyance capacity (outflow) of the canal given the limited capacity at the roadway crossings.

Table 2. Tolleson Area FDS.
Estimated Excess RID Canal Capacity vs. Possible Weir Inflow to Canal

Feature	Condition	Estimated Flow Rate
Canal[1]	Normal Flow Rate (y = 6 ft.)	300 cfs
Canal[1]	Canal Full (y = 10 ft.)	800 cfs
Canal[2]	Excess Canal Capacity Available	500 cfs
Crossing	Bridge With Tailwater = Canal Full	0 cfs
Weir[3]	Subreach Segment (L = 0.5 mi., H = 2 in.)	500 cfs
Weir[3]	Entire RID (L = 9 mi., H = 1 in.)	3,100 cfs

Notes:
1. Canal rating estimated using Manning, assuming 1:1 side slopes, 10 ft. depth, 0.03% slope, n=.02.
2. Canal full rating neglects limited capacity at roadway and lateral crossings.
3. Weir flow assumes C = 2.7

FDS HEC-RAS Modeling

The Tolleson Area FDS floodplain delineation will include HEC-RAS modeling of flow along the RID and SPRR, in addition to HEC-1 modeling of ponding areas using weir flow relationships. The following HEC-RAS modeling considerations are described in the paragraphs below, based on the field reconnaissance data:

- Manning's N Value Selection
- Determination of channel bank stations

[5] See Special Problem Report #2 for description of RID conveyance assumptions.

In practice, "n" values will be selected for each cross section based on features observed in the field and on the aerial photographs, using the typical values shown in Table 3 above. A composite "n" value will be computed by the HEC-RAS model.

Channel Bank Stations. No continuous defined channels exist in the HEC-RAS modeling reaches. Therefore, channel bank stations could not be defined based on topographic or geomorphic features. To account for these unusual floodplain characteristics, the following procedure was used:

- Left Bank Station. The left channel station was defined as the overflow point for the SPRR or RID. This station was also the furthest left station in the HEC-RAS model.

- Right Bank Station. The right channel station was defined at the edge of the effective flow boundary along the right side of the floodplain, or at points where a break in conveyance characteristics was thought to occur.

The area between the left and right bank stations generally encompassed the entire floodplain.

Overflow Areas. Overflow areas were modeled using HEC-1 storage routing and irregular weir calculations as described elsewhere in this report, and in the hydraulics report. Overflows of the RID and SPRR occur where the storage capacity is exceeded and flow over the lateral control (roads and canals) is limited. Within the HEC-RAS modeling reach, overflows estimated in the HEC-1 modeling task were accounted for in selection of the discharges at each cross section.

Bridge Dimensions. There are no bridges located in the study area that will be modeling using HEC-1 or HEC-RAS. Other hydraulic structures are described elsewhere in this memorandum.

Photographic Documentation. Photographic documentation of typical field conditions, floodplain delineation reaches and hydraulic structures is provided in Appendix A. Photographs show typical "n" value variation for selected channel reaches.

Summary

Field reconnaissance of the Tolleson Area FDS study area was conducted to support the floodplain delineation. Field tasks included collection of data to assist in definition of hydraulic controls and weirs, and identification of significant watershed characteristics. Photographic documentation of channel conditions was provided to support the field reconnaissance report, and is attached as Appendix A.

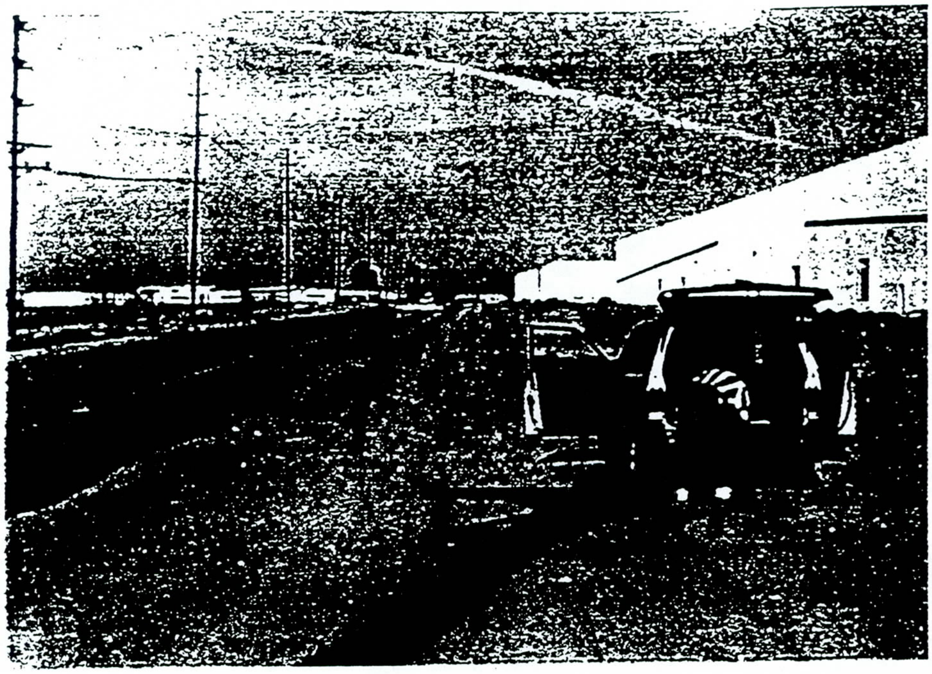

Figure A-1. View along north side of RID Canal, looking west from 39th Avenue alignment. Photo #5, Roll #1: March 29, 1996.

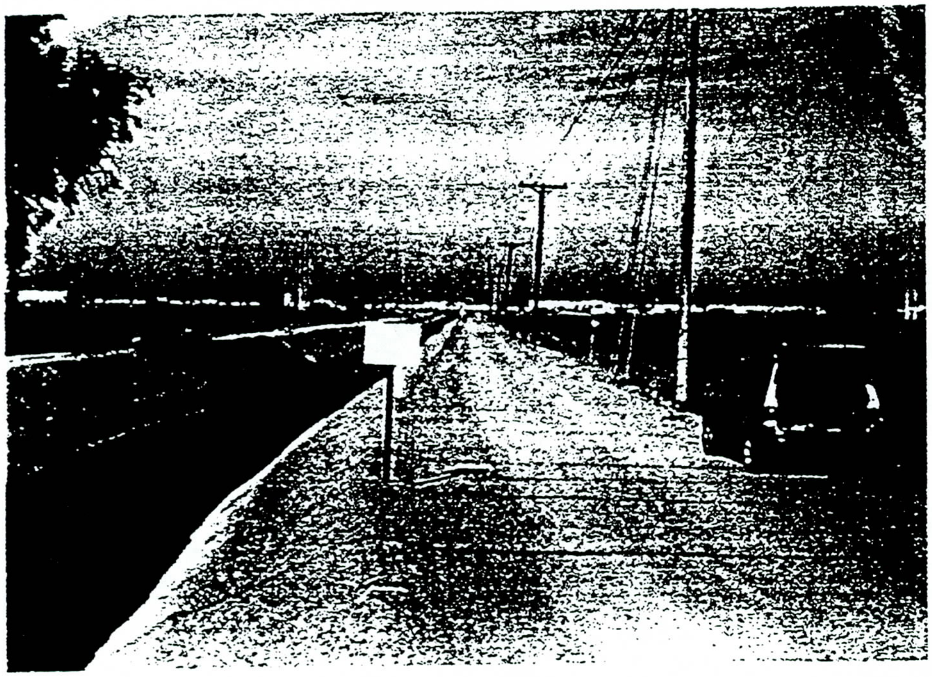

Figure A-2. View along north side of RID Canal, looking west from 43rd Avenue. Photo #9, Roll #1: March 29, 1996.

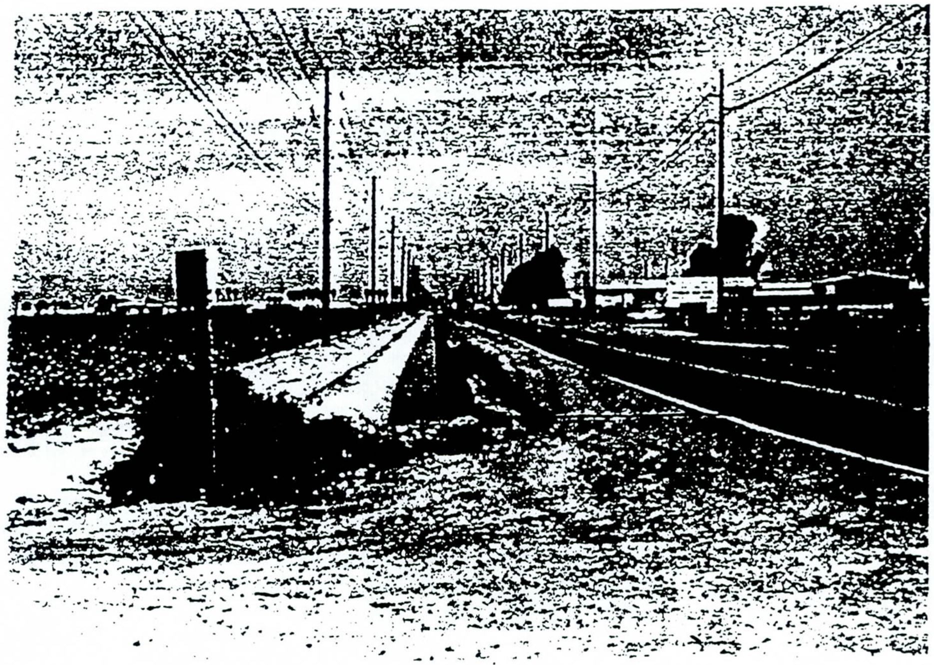

Figure A-3. View looking north along 59th Avenue from RID Canal crossing. Photo #17, Roll #1: March 29, 1996.

Figure A-4. Lateral crossing structure on RID Canal west of 59th Avenue. Note lack of freeboard at overchute. Photo #20, Roll #1: March 29, 1996.

Figure A-5. View of RID Canal banks west of 67th Avenue with SPRR grade in the background. Photo #24, Roll #1: March 29, 1996.

Figure A-6. View looking east along north side of SPRR toward 83rd Avenue. Photo #12, Roll #2: March 29, 1996.

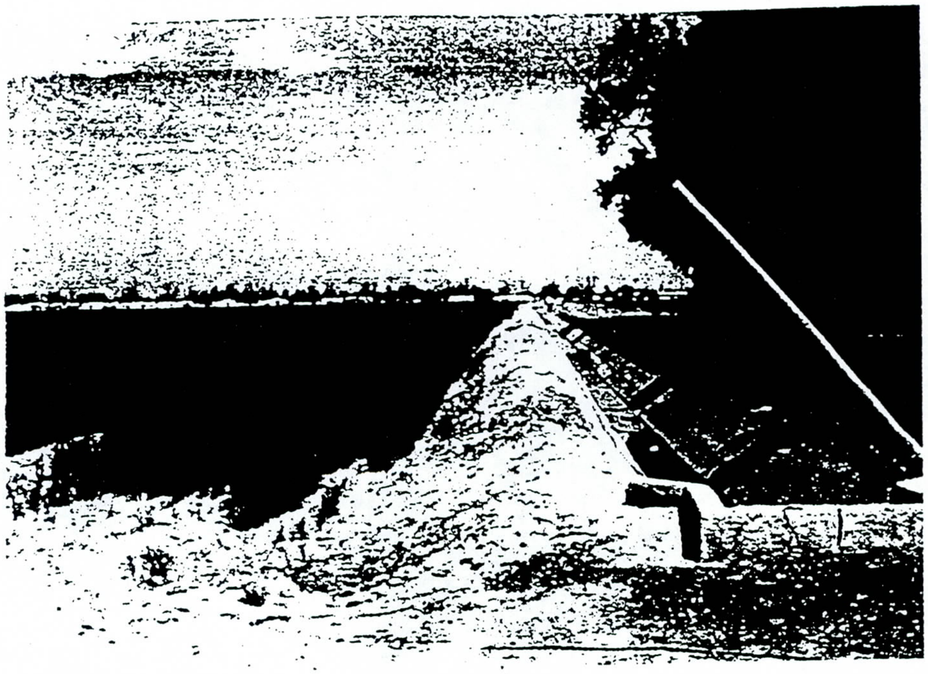

Figure A-7. View looking north along subwatershed drainage divide formed by irrigation lateral and agricultural field leveling along 87th Avenue alignment between subwatersheds RH and RI. Photo #14, Roll #2: March 29, 1996.

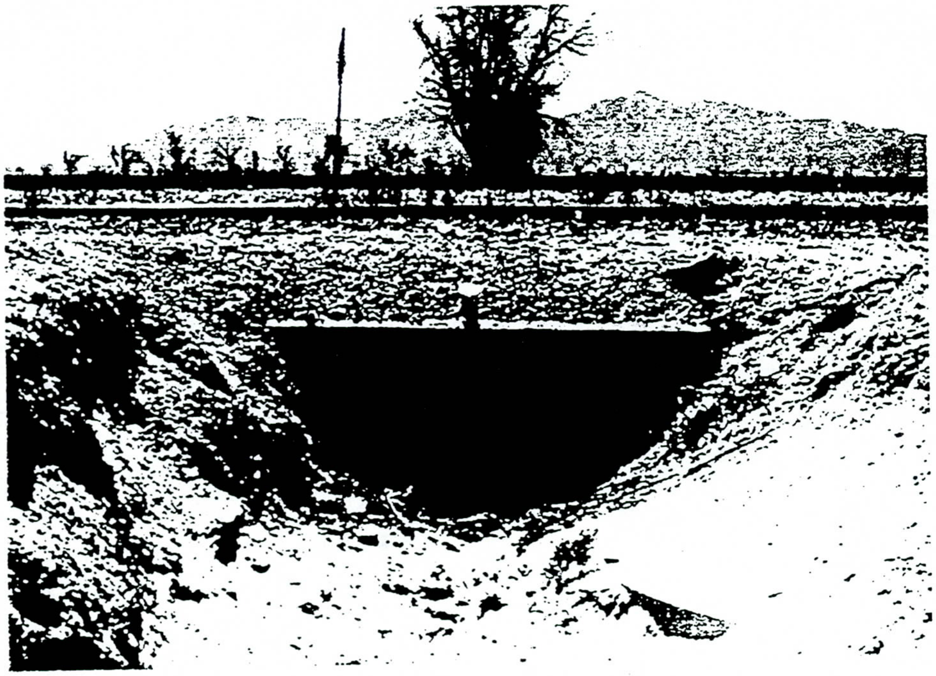

Figure A-8. Unblocked culvert under SPRR west of 91st Avenue. Photo #18, Roll #2: March 29, 1996.

Figure A-9. Culvert under SPRR blocked by farm access road crossing structure and debris, located east of 107th Avenue. Photo #24, Roll #2: March 29, 1996.

Figure A-10. View looking east along SPRR grade from 107th Avenue. Photo #27, Roll #2: March 29, 1996.

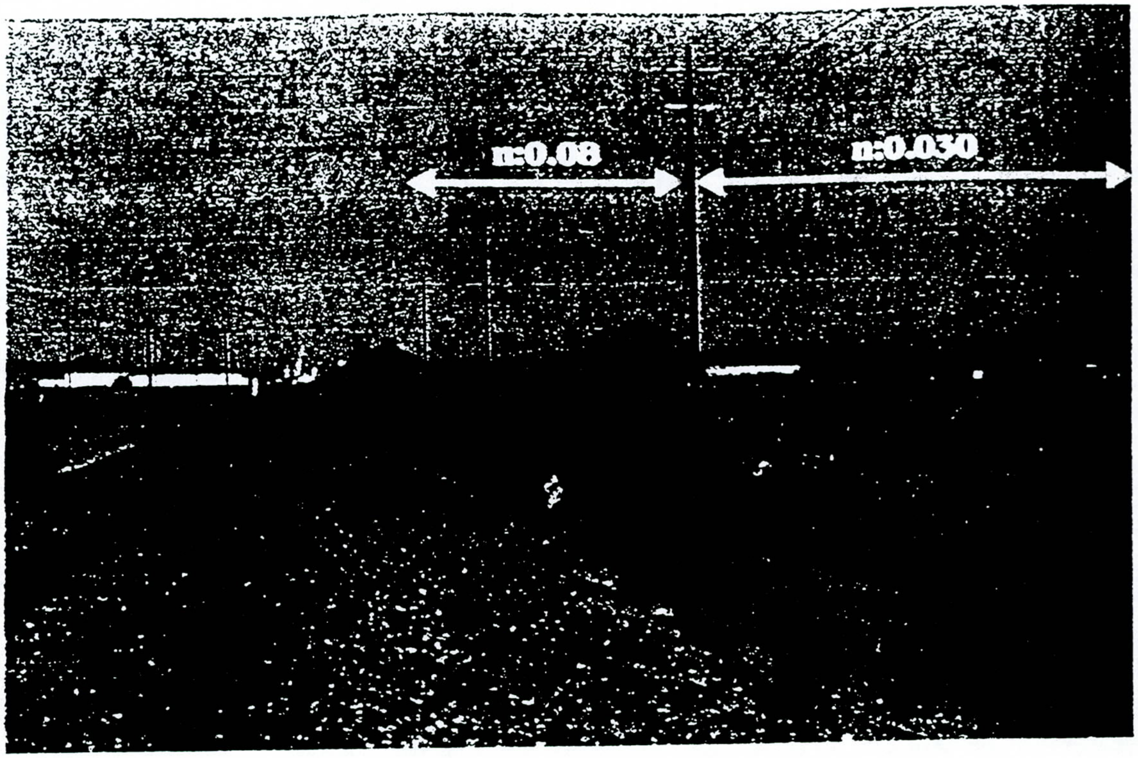

Figure A-11. View looking west along north side of SPRR west of 67th Avenue in HEC-RAS modeling reach. Photo #2, Roll #1: September 17, 1997.

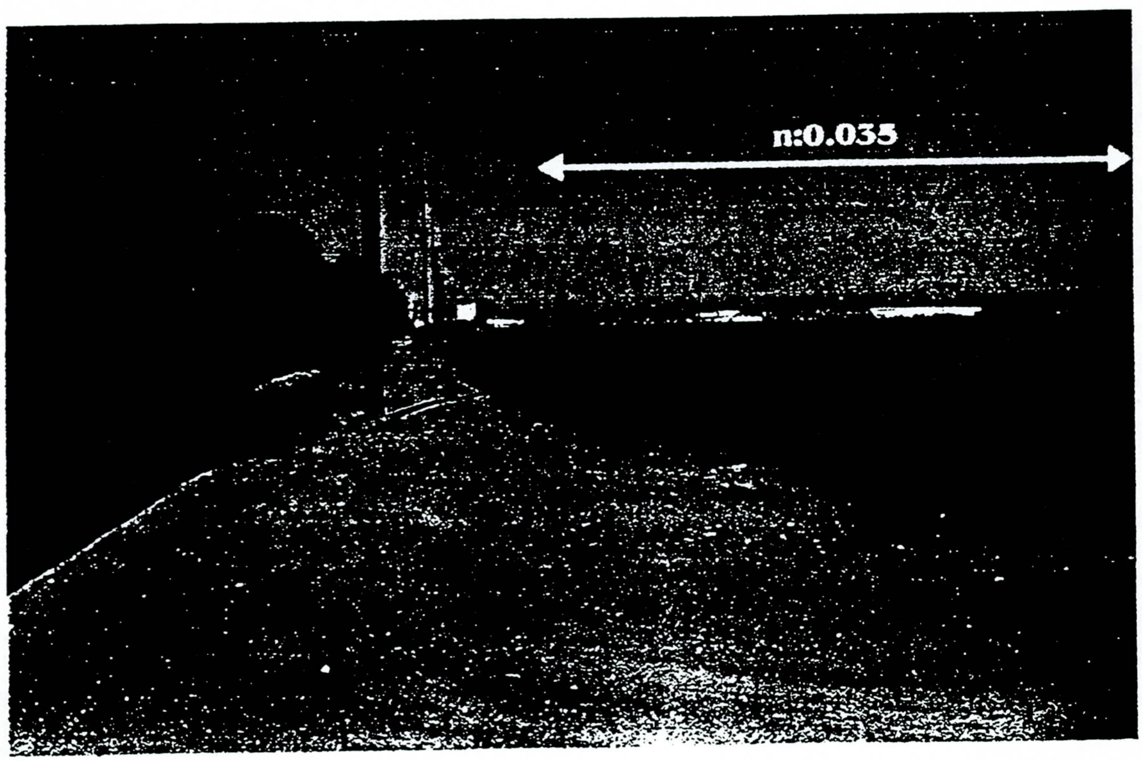

Figure A-12. View looking west in agricultural area (cotton) west of 67th Avenue in HEC-RAS modeling reach. Photo #5, Roll #1: September 17, 1997.

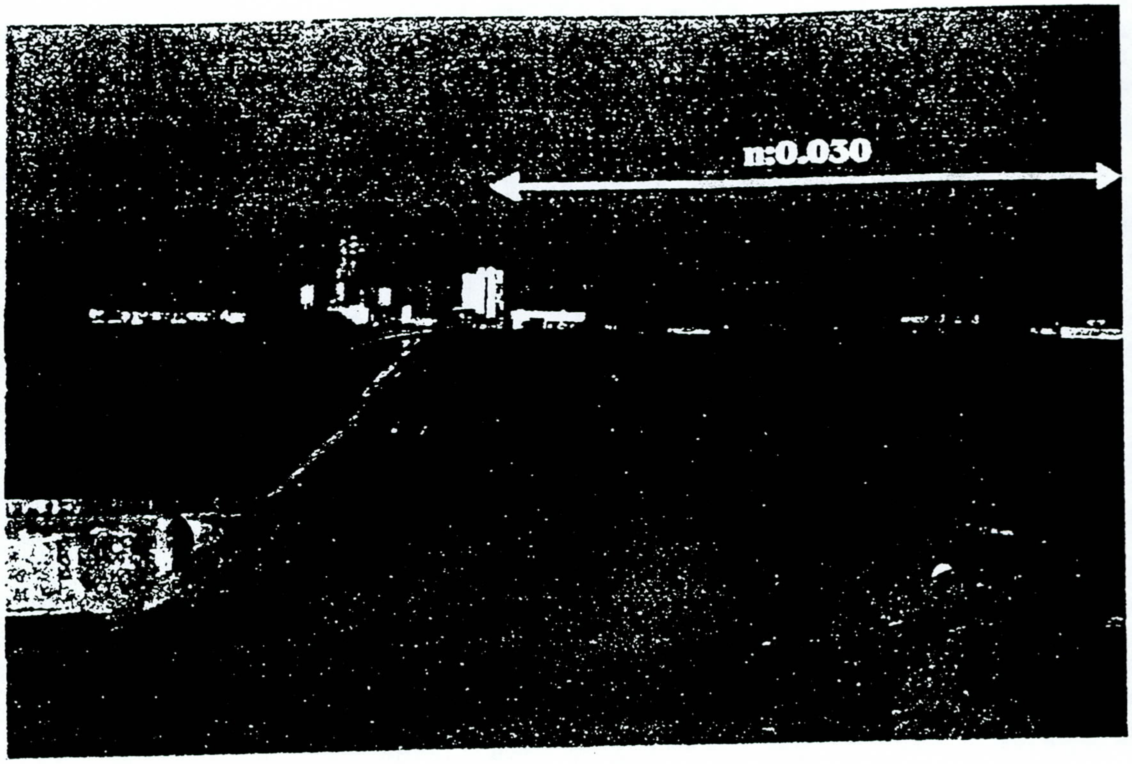

Figure A-13. View looking west along north side of RID in vacant agricultural area east of 75th Avenue in HEC-RAS modeling reach. Photo #7, Roll #1: September 17, 1997.

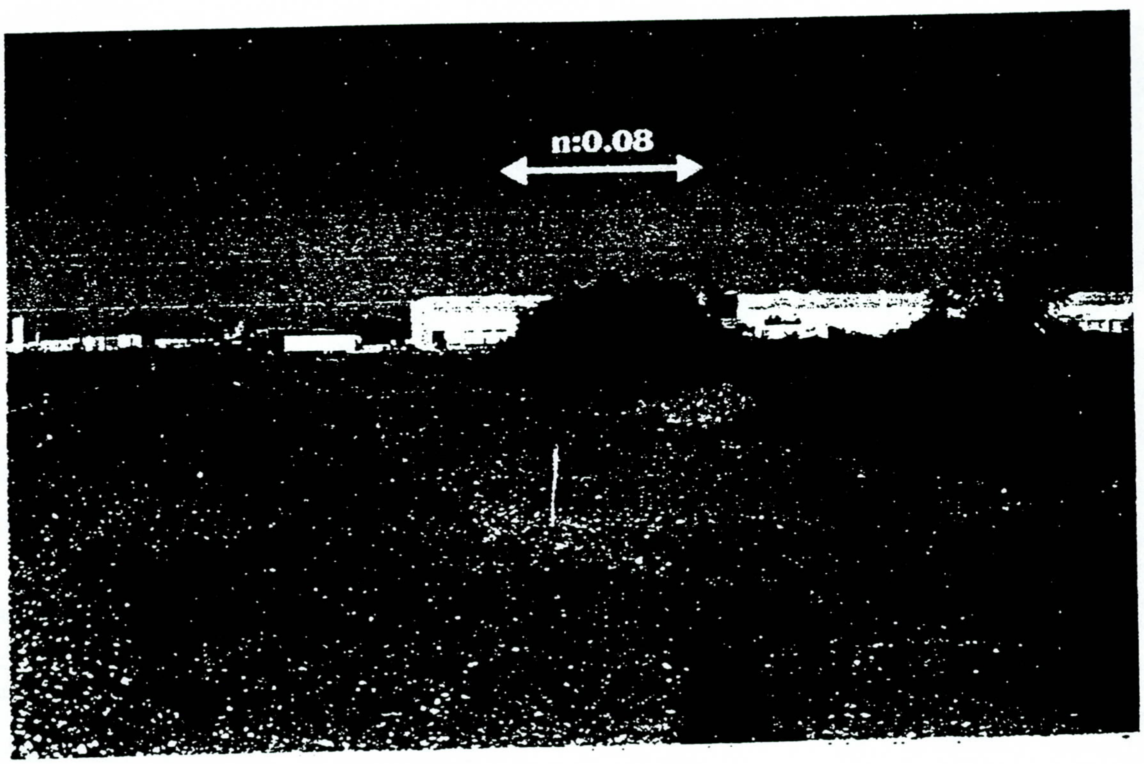

Figure A-14. View looking west along SPRR in industrial area with railroad spur west of 83rd Avenue in HEC-RAS modeling reach. Photo #11, Roll #1: September 17, 1997.

Figure A-15. View looking west over railroad spur north of SPRR in area converting use from agricultural to industrial east of 107th Avenue in HEC-RAS modeling reach. Photo #17, Roll #1: September 17, 1997.

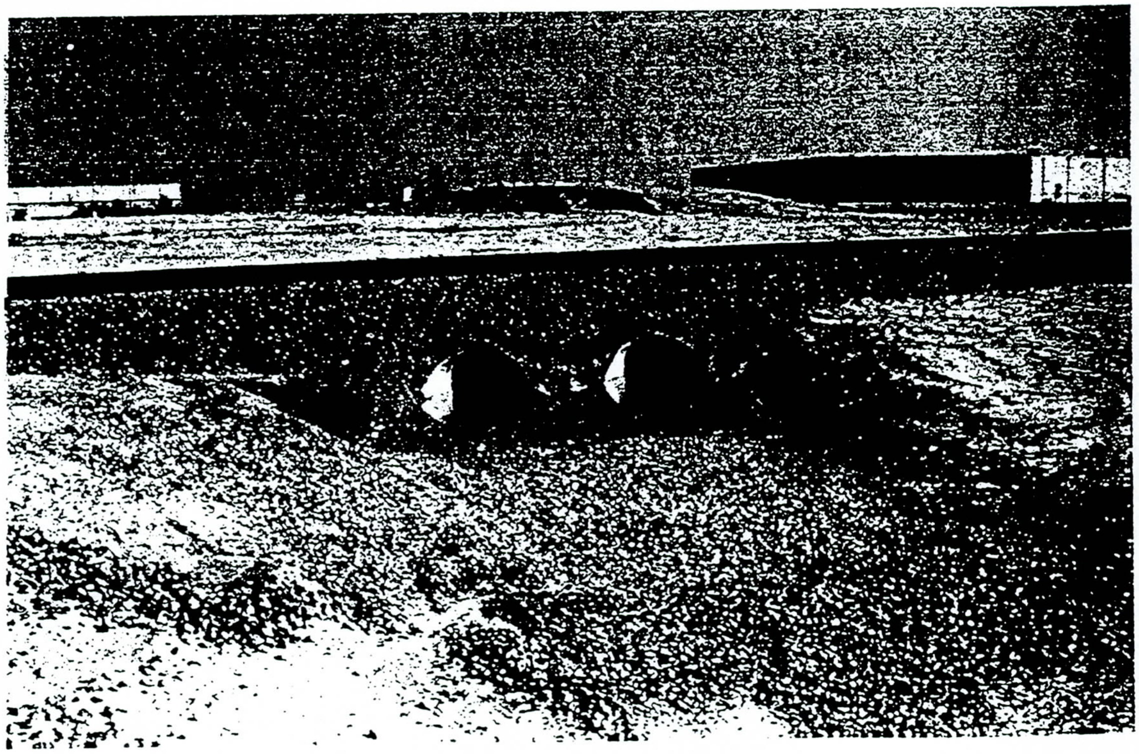

Figure A-16. Undersized, partially blocked 24-inch culverts typical of railroad crossings in study area. Photo location at spur east of 107th Avenue. Photo #19, Roll #1: September 17, 1997.

APPENDIX E-6: Excerpts from

Tolleson

General Plan – 1996

TOLLESON

GENERAL PLAN - 1996

CITY COUNCIL

ADOLFO F. GAMEZ, Mayor
MELINDA DIAZ, Vice-Mayor
LAURA ARNOLD
JACK CAUDLE
ALFREDO F. GAMEZ
STEVE GEM
FREDDIE D. VILLALON

PLANNING & ZONING COMMISSION

DRIES BOSCH, Chairman
B. DALE CRANDELL, Vice-Chairman
SUSAN A. BANKS, Commissioner
DAVID E. LAFFERTY, Commissioner
SALLY PIÑA, Commissioner

GENERAL PLAN COMMITTEE

SUSAN BANKS
DRIES BOSCH
ELSIE BUSSE
DALE CRANDEL
KATHY FARR
CHARLES MARRIOTT
DIEGO MORENO
JAMES SINOHUI
RUBEN VASQUEZ
NANCY URIBE

CITY STAFF/CONSULTANTS

RALPH VELEZ, City Manager
CHLOE L. CORREA, Admin. Assistant
SCOTT W. RUBY, City Attorney
ROSEMARIE M. BOOTH, City Clerk
DIANA T. QUEZADA, City Magistrate
GEORGE PICKETT, Fire Chief/Safety Services Director
SHERYL J. PIEPER, Library/C.A.P. Director
RICHARD A. PATSCHEIDER, Police Chief
MANUEL O. DOMINGUEZ, Public Works Director
R. SCOTT SCHROTH, WWTP Director
WOODROW C. SCOUTTEN, Consulting City Engineer,
W. C. Scoutten, Inc.

DAVA Z. HOFFMAN, Planning Consultant,
Dava & Associates, Inc.

CITY OF TOLLESON ARIZONA

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CHAPTER 1. TOLLESON AND THE GENERAL PLAN

INTRODUCTION

Tolleson is a unique city. It is an island of traditional values, with a strong sense of community surrounded by a sea of uncontrolled urban growth. Tolleson lies on the western fringe of Phoenix, one of the largest and fastest growing cities in the United States. Yet, unlike Phoenix and its numerous burgeoning suburbs, Tolleson has retained its compact, neighborhood-oriented land use form. The time-honored pattern is the envy of residents in most cities as expressed in national and local media covering the American frustration with expanding urban sprawl.

Over the past 10 to 15 years, most Arizona metropolitan cities experienced periods of great frenzied growth booms, often followed by years of slow-downs and even recession. Tolleson exhibited neither the "boom" nor "bust" cycles. The Tolleson population remained stable and maintained its strong sense of traditional values in family, community and culture.

The homogenous values and culture of Tolleson residents is reflected in their satisfaction with municipal services and in the community's low crime rate. These are tremendous assets for any city and provide the broad base upon which Tolleson will achieve its future goals.

The **GENERAL PLAN** is a statement of Tolleson's goals and strategies for its future. It is the summary report of a year's study by residents, business people, and local governmental leaders, augmented by community-wide input. The **GENERAL PLAN** serves as a guide for decision-making as the City continues to mature.

The **GENERAL PLAN** begins with a summary of primary issue areas and discussion of Tolleson's background. Several chapters follow, detailing the areas of circulation, economic development, community facilities, and land use. Each chapter contains the goals, policies and strategies pertinent to the subject. The issues, goals and strategies were developed from community-wide citizen survey responses, the General Plan Committee, and other public input. The simplified format of the **GENERAL PLAN** is purposely selected to allow for concentrated focus on primary issues.

PRIMARY ISSUES AND FOCUS

The city-wide citizen survey and public input from the General Plan Committee resulted in a focus on two primary issue areas:

- Economic Development
- Community Character

Economic Development issues focused on expansion, including the need for:

- Expanded local employment opportunities and job variety
- More retail business for the convenience of residents
- More recreation and entertainment centers for visitors and residents
- Enhanced "downtown" area for specialty retail, eateries and more festivals for residents and visitors
- Strengthening and expanding tax revenues for support of municipal services

Community Character issues focused on retention and enhancement, including the need for:

- Protection of existing neighborhoods
- Maintaining the compact, pedestrian-friendly land use pattern
- Enhanced walking and bicycling trails
- More quality housing
- A variety of housing types oriented to families and to the elderly
- Rehabilitation of abandoned and neglected buildings and homes
- Emphasis on trees and open-landscaped areas to retain a connection to Tolleson's agricultural roots

Circulation and land use patterns were identified as two principal keys to resolution of both issue areas. These elements are discussed later in individual chapters. Both economic development and community character are linked to Tolleson's history, population and location. A brief discussion of the City's background, setting and trends follows.

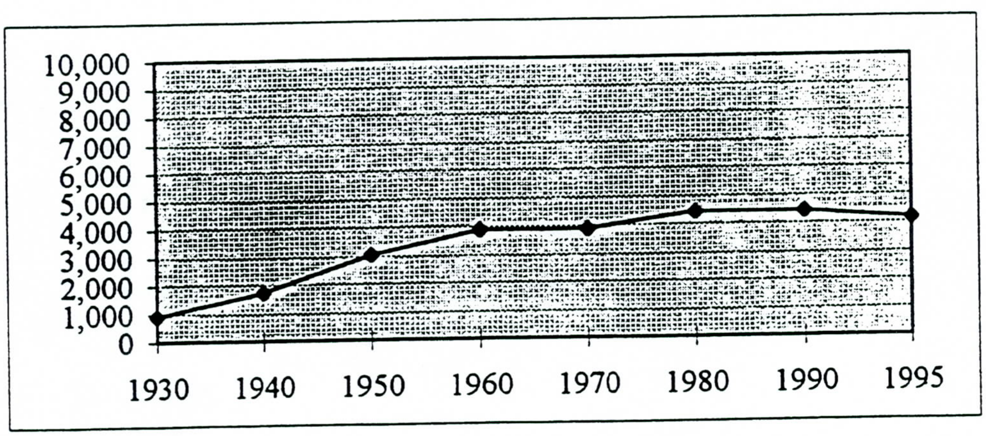
BACKGROUND AND POPULATION

Tolleson was incorporated in 1929, becoming a city in 1956. Its roots and name go back to 1910 with the purchase of a 160-acre ranch by Walter and Alethea Tolleson of South Carolina. The location of the Tolleson's ranch at the present day intersection of 91st Avenue and Van Buren was a convenient stagecoach stop for travelers to Yuma. Transportation continued to play an important part in Tolleson's history with the construction of the railroad throughout Arizona. Mr. Tolleson hired a train to bring residents of Phoenix to Tolleson for real estate sales promotion. Community growth had begun and flourished for several decades.

During the 1940's and '50's, Tolleson became known as the "Vegetable Capital of the World" as agricultural ventures expanded with the installation of irrigation canals. The growing agricultural industries and population resulted in new retail, entertainment and housing. In the 1960's, however, Tolleson experienced a decline in its employment base due to technological advancements in the farming industry. The previous upward trends in population and new business expansion ceased for the decade.

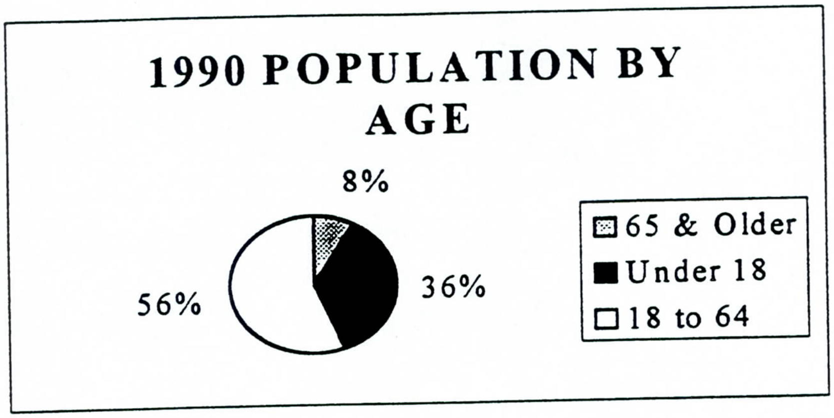
Undaunted, the Tolleson community planned for growth and necessary infrastructure improvements during the 1970's and '80's. The construction of a $2 million sewage treatment plant, beautification projects, and Van Buren Street revitalization attracted major industries to locate in Tolleson. Interstate 10 was completed, connecting Tolleson directly with Phoenix and Los Angeles. While this resulted in increasing population during the 1970's, the population has remained stable between 1980 and the 1990's. The preliminary 1995 mid-decade census represents a population of 4,261.

TOLLESON POPULATION TRENDS



Source: Department of Commerce, U.S. Census Bureau

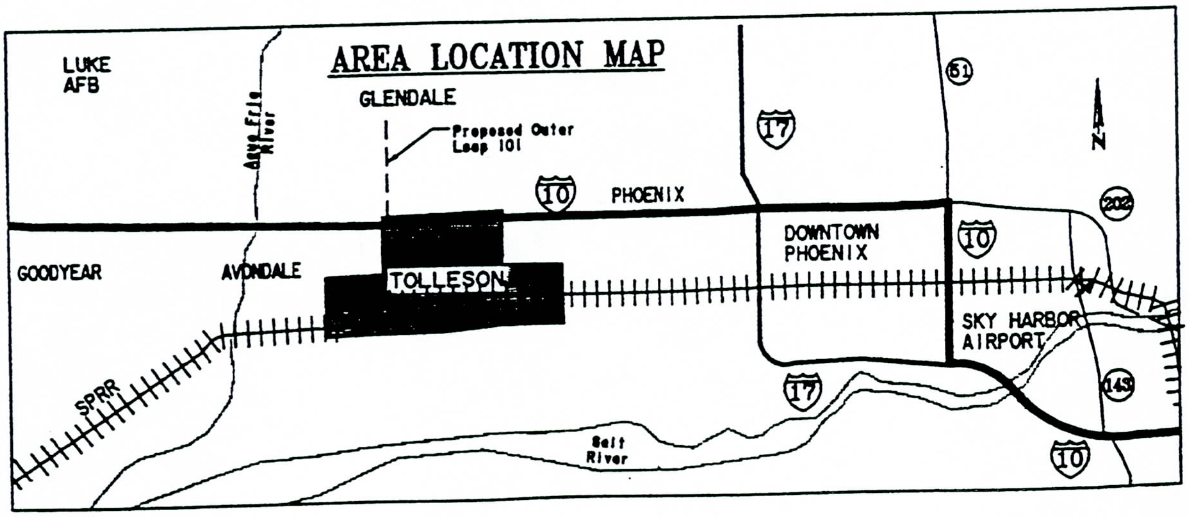
The 1990 U.S. Census data reflects Tolleson's traditional and cultural values. The population is nearly 75% Hispanic origin, with almost a 50/50 split between male and female. The city-wide number of persons per household is 3.65. This includes traditional family households and non-family households. Ninety-five percent (95%) of all Tolleson residents are living in family households, with an average of almost 4 persons per household. Five percent (5%) of the population live in non-family households, with less than 4% of the population living alone. The majority of residents are in the working-age years of 18 to 65, while 36% are children and 8% represent the senior citizens.



Source: 1990, U.S. Census

SETTING AND TRENDS

Tolleson comprises 6 square miles and is bounded on the north, east and south by the City of Phoenix. It lies 10 miles due west of downtown Phoenix and 13 miles west of Sky Harbor International Airport. To its west, Tolleson abuts the City of Avondale, with Goodyear and Litchfield Park nearby. The Sierra Estrella range forms a dramatic backdrop south of the City.



The majority of Tolleson is situated between two major transportation corridors: Interstate 10 and the Southern Pacific Railroad. Several properties along both corridors are currently undeveloped or in agricultural use, although zoned for commercial and industrial uses.

Tolleson's physical characteristics are ideal for continued development. The flat, lower Sonoran Desert terrain, with an average elevation of 1,025 feet, provides no obstacles to growth. The mild winters, warm summers and limited rainfall allow construction year-round.

The increasing urbanization and fast-growing populations of the Western Valley cities are expected to impact Tolleson. Projections by the Maricopa County Association of Governments foretells a quadrupling of the Southwest metropolitan area's population over the next 25 years.

SOUTHWEST METROPOLITAN REGION TRENDS

MUNICIPAL PLANNING AREA	POPULATION				
	1980	1990	1995 Census	1995* Projected	2020* Projected
Avondale	8,168	16,169	21,766	24,985	74,318
Goodyear	2,747	6,258	8,979	11,658	78,141
Litchfield Park	3,657	3,303	3,659	3,957	14,648
Tolleson	4,433	4,434	4,261	4,880	17,442
Unincorporated Area	N/A	N/A	N/A	14,360	43,030

Sources: U.S. Census and *Update of the Population and Socioeconomic Database for Maricopa County, AZ, MAG, March 1993

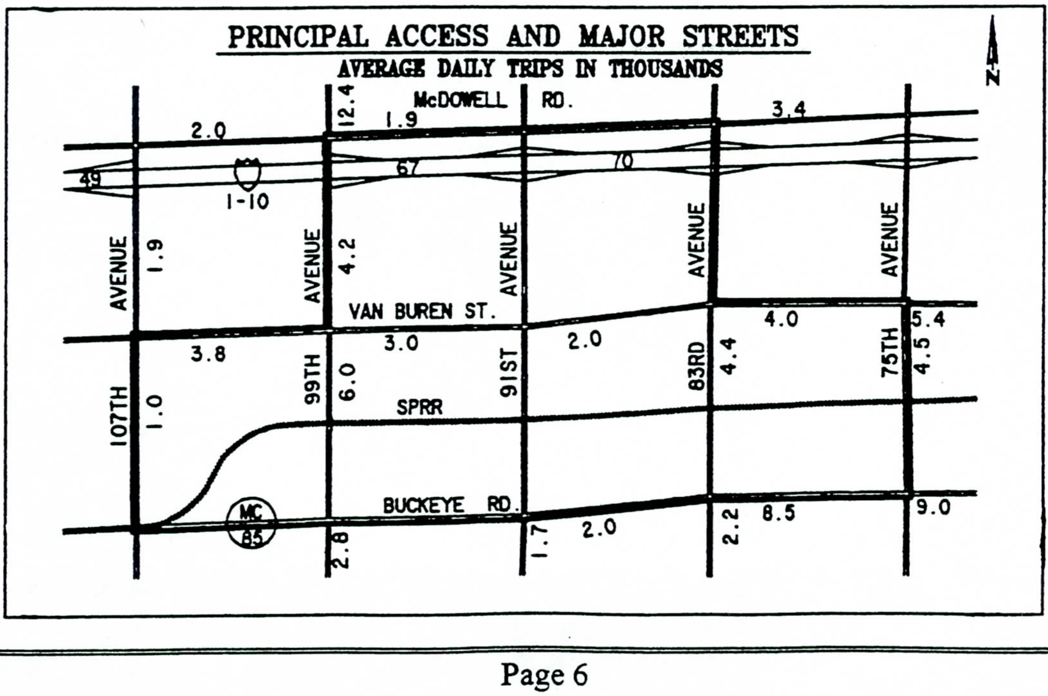
<u>NOTE</u>: Actual 1995 Mid-Decade Census for these cities reflect populations which are less than those projected by MAG above. The 1995 Mid-Decade Census for Tolleson is 4,261. The city projects a population of approximately 7,500 over the next 25 years.

PRINCIPAL TRANSPORTATION: INTERSTATE HIGHWAY AND MAJOR STREETS

The building of cross-country highways and interstate freeways resulted in dramatic changes in transportation. Railways, as the primary means of transportation, declined rapidly except for freight conveyance. Passenger rail service became minimal within Arizona long before the 1980's completion of U.S. Interstates 10 and 40 through the State. Linking Arizona with economic markets east and west via two of the nation's busiest freeways, the interstate highway network provides opportunity to many adjacent cities.

Interstate 10 bisects a 1/4-mile wide corridor through the City of Tolleson, south of McDowell Road running between 83rd Avenue and 99th Avenue. Three freeway interchanges provide direct access into Tolleson at 83rd, 91st and 99th Avenues. A fourth interchange serves Tolleson at 75th Avenue, approximately 1/2 mile north of the City's eastern edge. The two segments of I-10, 83rd to 91st and 91st to 99th Avenues, respectively, carry 70,000 and 60,000 average vehicle trips per day according to the November 1995 Southwest Valley Transportation Study of Maricopa County Department of Transportation. This equates to Interstate 10's heaviest traffic conditions in the southwest valley metropolitan area (75th Avenue west to S. Johnson Road in Buckeye). The eight-lane (from Phoenix to 91st Avenue) and six-lane (91st Avenue to Dysart Road) freeway segments are free-flowing and well below their acceptable level of service design capacities of 108,000 average daily trips.

Data from the Southwest Valley Transportation Study, 1995, indicate that Interstate 10 is the principal east/west route of Tolleson, followed by Buckeye Road with 8,500 average daily trips (A.D.T.), Van Buren Street with 4,000 A.D.T., and McDowell Road with 3,400 A.D.T. The major north/south streets from I-10 are 99th Avenue (6,000 A.D.T. south of I-10 and 12,400 A.D.T. north of I-10), 83rd Avenue (4,400 A.D.T.), and 75th Avenue (4,500 A.D.T.).



The intersection of most traffic intensity studied within the Tolleson city limits is Van Buren and 99th Avenue. This intersection contains an estimated daily total volume of 11,700 entering vehicles. This number is far below the threshold of 65,000 entering vehicle volume which first equates to intolerable traffic congestion at peak hours.

99th Avenue, Van Buren Street, and Buckeye Road are improved 4-lane major arterials designed to carry through traffic. The remaining major streets are 2-lane collectors, carrying local traffic within the City. 99th Avenue is planned to become part of the Outer Loop 101 freeway, connecting Tolleson at I-10 with metropolitan cities to the north and east to I-17. Construction of the remainder of the Outer Loop between Glendale Avenue and I-10 is proposed to be completed in 2006. Buckeye Road is part of Maricopa County Highway 85, which routes Tolleson residents to the Maricopa Freeway/I-10, southeast to Tucson, with connection to State Route 360, The Superstition Freeway, to Tempe, Mesa and Apache Junction.

INTERSTATE AND MAJOR STREET ISSUES, GOALS AND STRATEGIES

Issues: Interstate Access Routes

- Community desires 91st Avenue to become enhanced principal access for residential and tourist traffic, not primary truck route
- Community prefers principal truck and industrial traffic on 99th Avenue, already fully improved major arterial

Goal:

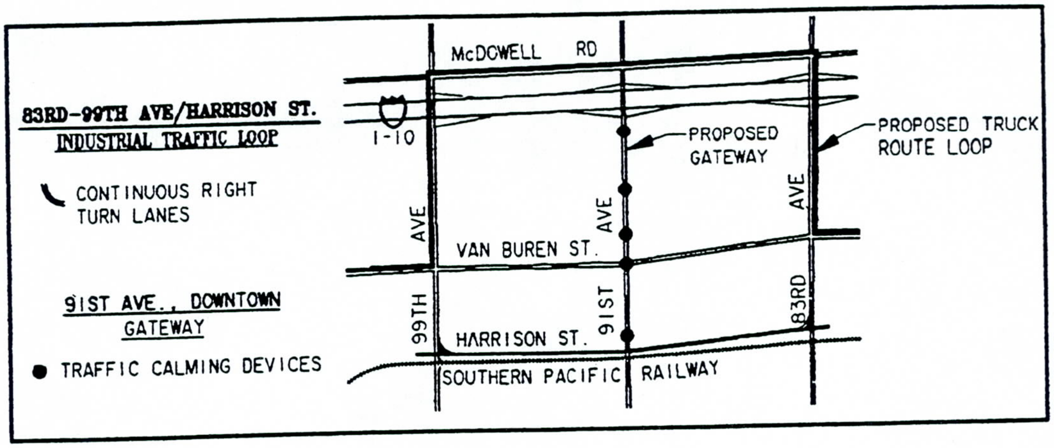
Create enhanced principal gateway for residents and visitors, while providing other improved routing for industrial traffic.

Strategies:

- Request Arizona Department of Transportation to place signage on I-10 establishing 91st Avenue as "Tolleson Downtown Center/Visitor Information" exit, and 83rd and 99th Avenues for truck traffic;
- Request funds from Maricopa Association of Government Transportation Improvement Program, Maricopa County, Arizona Department of Transportation or new voters' street improvement bond election for 91st Avenue improvements for: resurfacing the two existing traffic lanes, adding turning bays, curbs and gutters, screening walls, and sidewalks enhanced with landscaping (additional to existing trees) instead of widening it to 4 lanes;
- Request Salt River Project to cover their 91st Avenue irrigation canal through City negotiations and citizen petitions to eliminate pedestrian and traffic hazards;

- Install landscaped traffic calming devices on 91st Avenue (e.g., center medians, stop signs and pedestrian crossing safety islands and crosswalks) at 5 locations: (1) just south of I-10 at Christa Way, (2) at McKinley/Lillian, (3) at Taylor Street, (4) at Van Buren Street and (5) just north of Harrison Street;

- Acquire right-of-way from Southern Pacific Railroad and others to complete Harrison Street between 83rd Avenue and 99th Avenue, and install continuous right-turn lane west bound onto Harrison from 83rd Avenue and north bound onto 99th Avenue from Harrison to facilitate industrial traffic as depicted below:



- Establish street improvement/beautification impact fee on new and major expansions of industrial and commercial businesses to aid funding of Harrison right-of-way acquisition/improvements, 91st Avenue and other major street improvement/beautification, or fund through new voter street improvement bond election;

- Encourage Maricopa County and the City of Phoenix to conduct a traffic/land use projections study for 83rd and 75th Avenues to begin planning for their widenings to 4-lane major arterial standard.

Issues: *"Main" Street/Central Business District*

- Community desires to enhance travel experience and business development on Van Buren Street for residents and visitors

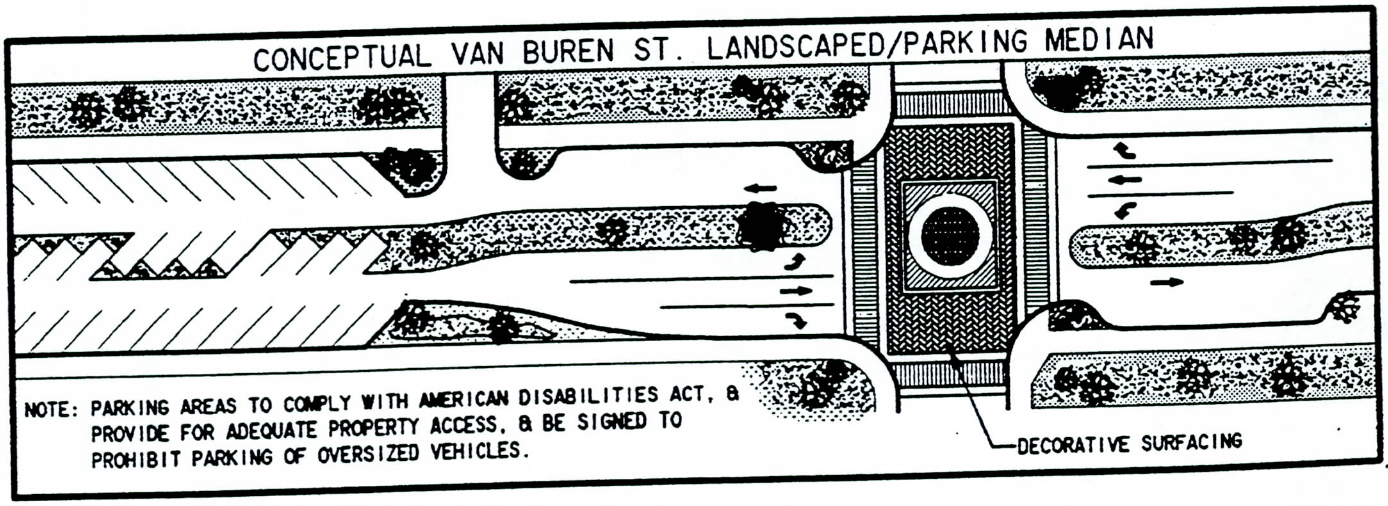
- Community desires to discourage 'speed-trap' reputation and create safe traffic flow for vehicles and pedestrians

Goal:

Create enhanced 'main street' experience on Van Buren Street for traffic convenience, revitalized community character, and economic development.

Strategies:

- Reinstall trees and landscaped center medians between 91st and 99th Avenues with parking and turning bays as needed; and continue landscaped median/parking east to 83rd Avenue as second phase of improvements;

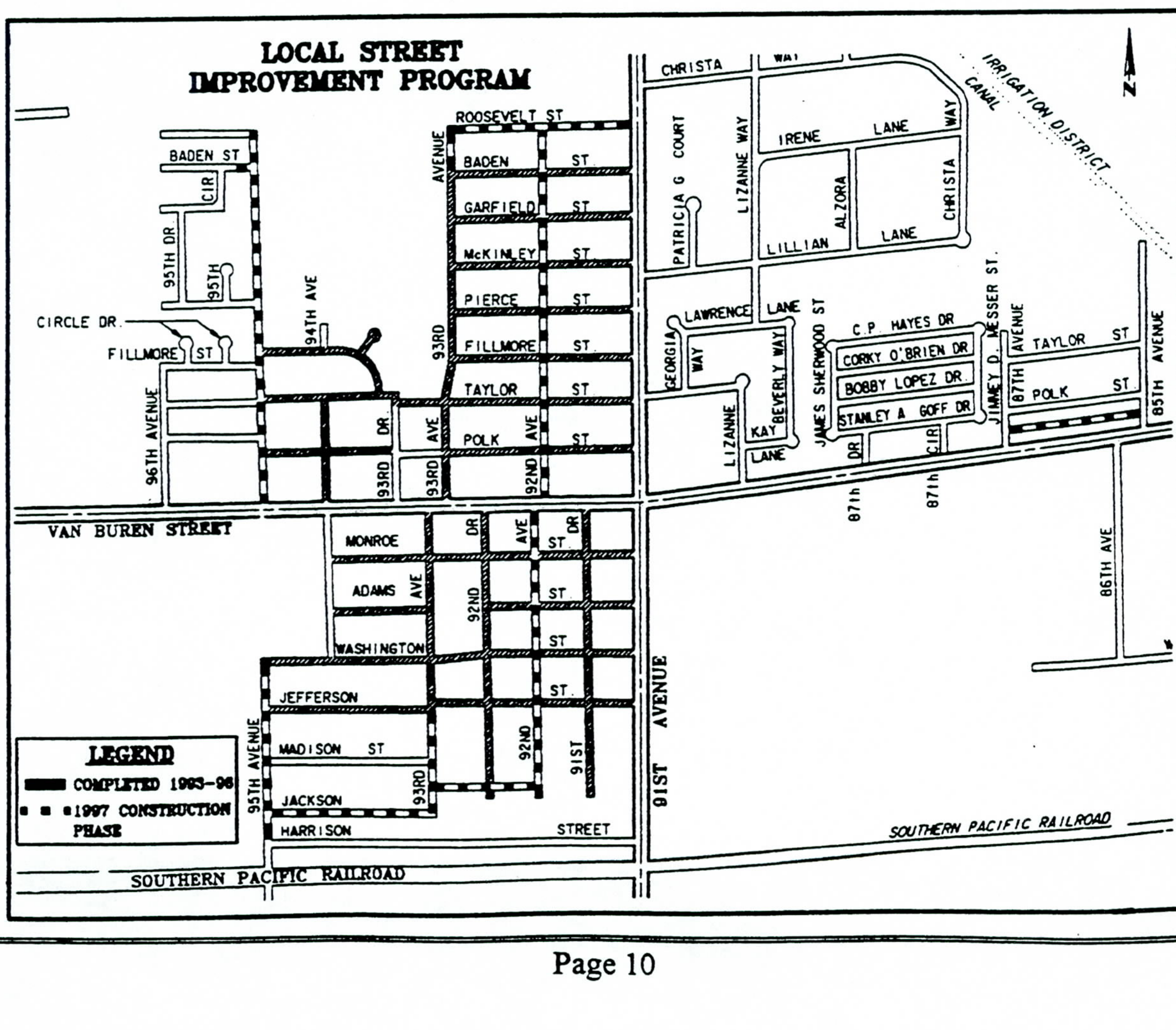


- Request school district to remove portable school crossing signs during the day between school start and close periods, and to help resolve the haphazard crossings by high school students through the installation of a caution or pedestrian-operated traffic signal at one location near the high school's front.

LOCAL STREETS AND ALTERNATIVE TRANSPORTATION

The remaining streets in Tolleson are local streets principally serving residential neighborhoods. The original town-site street design is a grid system with local streets running perpendicular to each other and to the major streets located along section lines. The local streets between 91st and 95th Avenues are short, flat and closely positioned, creating optimum ease for the pedestrian as well as the motorist. The streets were planned for urban land usage with pavement, curb, gutter and sidewalks.

During the late 1980's and early 1990's, Tolleson conducted street studies to ascertain the condition of existing local roadways. Most streets were found to be in a deteriorated state. Recommendations and costs for improvements to the majority of Tolleson's streets were made, resulting in a street improvement bond issue going to Tolleson voters. A $2.9 million transportation bond issue was passed in March 1993 for acquisition, construction and reconstruction of streets, alleys and highways within the City. The Council commenced a comprehensive street reconstruction program in 1993/94. The first two phases have been completed. Engineering design contracts for the last phase are being considered, with construction expected to begin in 1997. It is doubtful, however, that the remaining street improvement bond dollars will be sufficient to complete all of the streets in the last phase. The City may propose another street improvement bond election for completion of local street reconstruction, combined with new improvements to 91st Avenue and the Harrison Street acquisition and construction.



The City's Public Works Department is developing a policy and budgeting program for maintenance of all local streets. The program will be administered on a rotating basis enabling five-year periodic maintenance and preservation methods for all streets.

Issues: Local Streets, Pedestrian and Bicycle Routes

- Residents expect street improvements to be completed and continually maintained
- Residents desire enhanced pedestrian and bicycling routes

Goal:

Continue improvements, enhancements and maintenance of streets for motorists, bicyclists and pedestrians.

Strategies:

- Continue the reconstruction of streets and alleys as directed by Council through residents' bond election;
- Implement program for annual and/or periodic maintenance of newly improved and other streets and alleys;
- Enhance pedestrian walkways through planning and funding a neighborhood street lighting and landscaping program;
- Install bicycle lane striping on streets and/or paths to create continuous trails between residential areas, schools and parks;
- Discourage speeding through residential streets, such as Taylor Street, by increased traffic control enforcement and by installing traffic calming devices, such as speed bumps or center median islands, as appropriate.

TRANSIT AND RAIL

Transit is limited to one express route connecting Tolleson with downtown Phoenix, the State Capitol and Westridge Mall. Bus route 560 of the Regional Public Transportation Authority (RPTA) provides four road trips per day on weekdays, also connecting Tolleson residents with Avondale and Goodyear. Three bus stops are located along Van Buren Street and two on 91st Avenue. Greyhound Bus Lines serves Tolleson enroute between Phoenix and Southern California on a limited basis. The Greyhound depot is at 9258 W. Van Buren. The American Red Cross and Maricopa County Human Resources Department provide a limited amount of demand-responsive service for the handicapped and elderly in the southwest valley.

Southern Pacific Railroad provides Tolleson with freight service along its right-of-way located 1/2 mile north of Buckeye Road. Amtrak provided passenger service between Phoenix and Southern California, but recently discontinued this service.

Issues: Transit and Rail

- Tolleson residents desire expanded transit services

- The community desires to retain the freight rail services and encourage limited tourist passenger service

***Goal*:**

Retain, enhance and expand transit and rail services in Tolleson.

***Strategies*:**

- Enhance regional transit usage by providing bus stop shelters, benches and landscaping;

- Add more regional bus stop locations along Van Buren and 91st Avenue;

- Investigate expansion of demand-responsive transportation, such as 'Dial-A-Ride,' and charitable transportation services for the elderly and handicapped;

- Encourage Southern Pacific to continue freight rail services in Tolleson and Southwest Valley cities;

- Explore forming intergovernmental agreements (IGA) with cities, such as Goodyear, Avondale, Phoenix, Tempe and Mesa, to establish a commuter or Winter season tourist passenger rail service with Southern Pacific.

CHAPTER 3. ECONOMIC DEVELOPMENT

EMPLOYMENT CORRIDORS AND OPPORTUNITIES

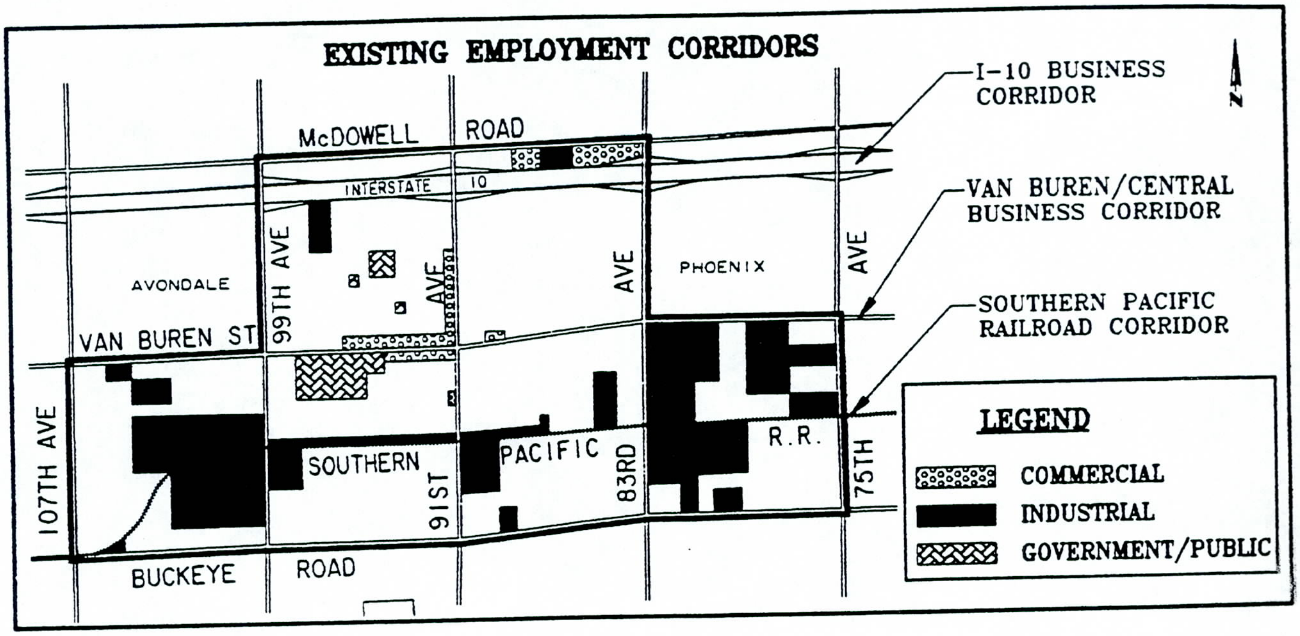
Transportation has always aided the City of Tolleson in its development. Historically, the train brought travelers, new residents and businesses to Tolleson. Although rail was replaced by the Interstate highway for passenger circulation, it continues to provide a major economic factor for the City.

The Southern Pacific railway corridor has been a magnet attracting major industry into Tolleson for many years. The majority of Tolleson's largest employers are located adjacent to or within a half mile of the railroad right-of-way, in the south half of the City. The 15 largest employers in Tolleson's south side rail corridor are:

EMPLOYER	# OF EMPLOYEES
Sun Land Beef	925
Smith's Food & Drug	735
Albertson's Food & Drug	403
Salt River Project	397
Sysco Food Services of Arizona	384
Borden, Inc., Creamette Co.	300
Auto Auction of Greater Phoenix	210
Wincup Holding Co.	200
AutoZone	192
Lisanti Foods	175
Power Packaging (Snapple)	130
Aqua Pore Moisture System	52
Price/Costco	50
Everkrisp Vegetables, Inc.	45
Bay State Milling	40

A second important employment corridor is developing on Tolleson's north side bordering its other primary transportation system, the Interstate 10 freeway. More recent businesses in this area include manufacturing: Reckitt & Coleman (50 employees) and Parker-Hanniflin (92 employees); and retailing: K-Mart (141 employees), EconoLodge, Waffle House, Circle K, and Jack-in-the-Box.

A third employment and business corridor runs along Tolleson's central corridor, Van Buren Street between 91st and 99th Avenues. This former state highway was once the major retail and business center for Tolleson and the surrounding areas. It still contains important employment centers, such as the Tolleson Elementary School District (100 employees), Tolleson Union High School (220 employees), and the City of Tolleson (110 employees), although its private businesses are generally limited to small retail and service shops. The more recent construction of Tolleson Plaza, across from City Hall, has added new businesses, including Sonic Burger and the Subway eateries. Enhancements to the streetscape with Tolleson's recent revitalization program of Van Buren Street west of 91st Avenue has also strengthened the business environment.



EMPLOYMENT OPPORTUNITIES

The large employment bases located along the Southern Pacific railway corridor and the I-10 freeway corridor, augmented by the Van Buren Street/Central Business corridor, provide ample job opportunities. It is estimated that 5,000 are employed by the major industries and institutions named previously. The primary types of employment in Tolleson, however, are largely in warehousing and agriculture/foods packaging. Professional jobs are generally limited to government and public agencies. Retail, service, food and beverage businesses offer small numbers of employment opportunities within Tolleson. Residents also find employment outside of Tolleson in the greater Phoenix area or at Luke Air Force Base and the Palo Verde Nuclear Generating Station.

Tolleson residents provide a potentially large employment force, with 56% of its population in the working age category of 18 to 64. The Arizona Department of Economic Security estimates that approximately 2300 Tolleson residents were in the civilian labor force as of 1994, with less than 9% unemployed.

Although Tolleson's unemployment rate lowered to less than 7% in 1995, it is still higher than that in the Phoenix area and the county.

UNEMPLOYMENT RATES		
	1990	1995
Maricopa County and Indian Reservation	4.3%	3.7%
Greater Phoenix & Mesa	4.4%	3.8%
Tolleson	7.9%	6.8%

Source: Labor Market Information Department, Arizona Department of Economic Security

Issues: Local Employment

- Community desires more diversity of job types within Tolleson
- Community requests more employment by local businesses

Goal:

Create more diversity of jobs and training for Tolleson residents.

Strategies:

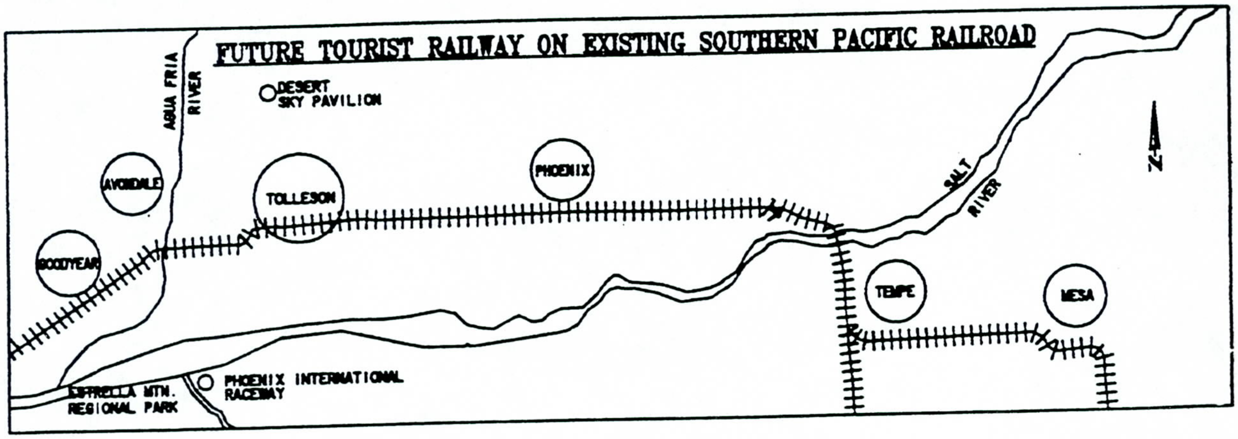
- Focus economic development efforts on expanding retail, service and professional businesses, rather than on warehousing and food handling business;
- Encourage coordinated efforts by local major employers and Estrella College to begin a retraining program for replacement of diminishing agriculture business employment;
- Request Estrella College to offer vocational and basic job skills programs, including resume/application preparation and interview techniques;
- Support the construction of the Maricopa Skill Center to provide specific job training programs;
- Encourage Tolleson's major employers to offer employment advantages to local residents, such as six months' on-site training or tuition-paid training programs at colleges;
- Encourage local businesses to participate in the Western Maricopa Enterprise Zone.

ECONOMIC DEVELOPMENT

As described previously, two of Tolleson's major employment corridors are enhanced by national transportation arteries. During the past fifteen years, the properties along the Southern Pacific and I-10 corridors have been developing with major businesses, primarily warehousing and light industry. Lisanti, a cheese processing/packaging company is under construction at Van Buren and 104th Avenue near a new warehouse constructed by the Mack Company. Although there are currently some vacant properties along the two prominent employment corridors, their prime locations ensure their future development. Other types of business development may also be suitable resulting from their proximity to major transportation routes.

The Southern Pacific Railway Corridor

It is expected that more warehousing, distribution and light industry will locate near the Southern Pacific corridor, taking advantage of its freight service. The railroad, however, may have another economic development attribute. Its alignment connects many of the greater Phoenix area cities, some with existing and former passenger depots. The formation of an intergovernmental agreement among these cities to provide a winter season passenger rail service would allow Tolleson to share in the economic benefits of tourism, Arizona's largest industry.

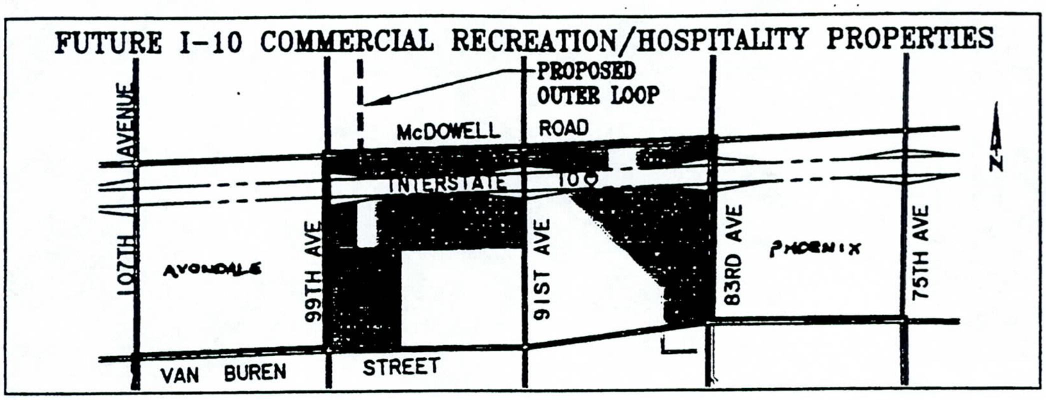


The I-10 Freeway Business Corridor

There are several sizable, undeveloped properties along the I-10 corridor, each located along Tolleson's major freeway access routes: 83rd, 91st and 99th Avenues. With 60,000 to 70,000 cars per day on I-10 in this area, these properties are prime for commercial development.

Tolleson's northeast area at 83rd Avenue and I-10 is approximately 1/2 mile from Blockbuster Desert Sky Pavilion. This entertainment facility contains 18,000 seats and produces 50 major shows per year, equating to a potential 900,000 visitors annually within 1/2 mile of the Tolleson city limits. The Phoenix International Raceway (PIR) is approximately 5 miles southwest of Tolleson's southwest section. PIR sponsors major automobile races with at least 4 national races and other entertainment events annually. Estrella Mountain Regional Park is just beyond PIR, also drawing visitors through Tolleson's I-10 freeway corridor for recreational activities.

The types of development, which benefit most from the high traffic volumes on I-10 and which provide highest returns to Tolleson, are major retail centers, major commercial recreation facilities, hospitality/tourism centers, and combinations of these uses. Surplus effluent from Tolleson's treatment plant might be used as an incentive for the development of a golf course-hotel-recreation center or other type of hospitality businesses. A major open space feature, such as a golf course, would be a suitable buffer around either existing residential neighborhood south of I-10, as well as buffering from 99th Avenue's proposed Outer Loop 101 connection.



The Van Buren/Central Business Corridor

Unlike the Southern Pacific and I-10 employment corridors, Tolleson's third business area, the Van Buren/Central Business corridor, lacks the attraction of a major, national transportation route. Before the Interstate freeway network, Van Buren Street was the primary east-west artery from the State capitol in Phoenix. Businesses flourished along this "Main Street" of Tolleson during the City's early growing years. Today, it provides minor retail and services to the local community. City-wide surveys indicate that residents desire expansion of business in Tolleson to serve their needs. Among the types of business most often mentioned were food and drug stores, sit-in restaurants and coffee shops, movie theaters, banks, more local retail and service shops, and professional offices.

Many of the shopping and service needs identified by Tolleson residents could be met by expansion of business in the Van Buren/Central Business corridor. Large-scaled commercial uses, such as major supermarkets or multiplex movie theaters, are more suitable to properties in the I-10 corridor or along 99th Avenue for high traffic and large parking accommodations. Tolleson's Van Buren/Central Business area, historically and currently, is characterized by a 'Main Street' appearance of densely placed, small-scaled businesses, on-street parking, and lower, slower traffic conducive to pedestrian convenience.

Enhancement of Van Buren's "Main Street" character serves also to attract visitors from other Phoenix area communities and tourists traveling on I-10 to or from California. Recent revitalization of Van Buren's streetscape and building facades between 91st and 94th Avenues, was a dramatic improvement and first step to this economic development technique. As new businesses develop compatibly with the character, appearance and scale of the revitalized buildings, they will add to the viability of the area. The attractive and expanded central business corridor will encourage the several thousand non-residents employed within a half mile to buy meals, office and personal products and services in Tolleson.

Increasing parking within the street through the addition of diagonal, curb-side and landscaped median parking, as discussed in the Circulation and Transportation Chapter, will provide incentive to new businesses to locate in the Central Business District. The parking aisles and landscaping will also act as traffic calming and street beautification devices, enhancing Tolleson's image and encouraging the pedestrian-oriented atmosphere.

A successful central business district requires activity as well as attractive buildings and streetscapes. Tolleson residents and businesses participate in many festivals celebrating national and religious holidays, war memorials, sister city and ethnic cultural events. The citizen survey stressed the desire for more entertainment and activities through the expansion of cultural events, carnivals, parades, arts/crafts shows, and performances. Festivals and cultural events attract visitors to spend time and money in central Tolleson, strengthening its economy.

Issues: Economic Development

- Community desires more retail and service businesses for residents' necessities
- Community desires more entertainment and recreational facilities
- City needs more business and tourist revenues to support services as the community grows

Goal:

> ***Encourage more businesses to accommodate residential community needs and to promote Tolleson as a tourist destination point.***

Strategies:

- Appoint an Economic Development Advisory Committee with local businessmen, residents, City Council and Staff members to recommend and set priorities toward fulfilling the economic development goal and strategies;
- Investigate hiring or contracting for an Economic Development Director to market Tolleson to the targeted, sales-tax generating businesses in the economic development strategies;
- Provide incentives through landscaping and street parking aisle enhancements for small-scaled, 'Main Street' character, businesses in the Van Buren/Central Business Corridor that specialize in products and services needed by the community;
- Encourage the expansion of clustered, small-scaled 'main street' shops fronting on Van Buren eastward between 91st and 83rd Avenues, with parking behind the buildings rather than in front;
- Solicit targeted major retailers, such as supermarkets, drug stores and movie theaters, to build needed shopping and entertainment complexes with compatible building scale, style and buffers in suitable locations, e.g., 99th Avenue;

- Facilitate small-scaled, 'Main Street' character businesses which specialize in merchandise and services that are not commonly found in the greater Phoenix area or that emphasize Tolleson's heritage, such as farmers markets and Hispanic/Native American arts sales;

- Coordinate with local businesses and Tolleson Chamber of Commerce to determine business specialties existing in Tolleson which can be strengthened by expansion of similar and related businesses;

- Investigate funding sources for revitalization, rehabilitation and beautification of buildings and walkways along the west side of 91st Avenue between I-10 and Van Buren;

- Request 'Downtown Center/Visitor's Information' signage on I-10 for the 91st Avenue exit;

- Coordinate and encourage more all day and night-time events and community/cultural festivities in the Van Buren/Central Business Corridor to create an image of Tolleson as a destination 'activity center;'

- Augment advertising campaigns for events and festivities to all parts of the Greater Phoenix Area and other selected Arizona and California cities;

- Expand upon existing assets attractive to visitors, such as the Southwest artifact collection; e.g., rehabilitate older buildings on Van Buren for retailing businesses, a cafe and the relocation of the artifact collection museum, in conjunction with an annual Native American festival;

- Provide incentives, such as surplus treated effluent, to encourage development of a golf course/hotel/restaurant facility into prime freeway locations; e.g., 83rd or 91st Avenues, to provide recreation, generate revenues, and buffer existing residential neighborhoods;

- Provide incentives for other outdoor commercial recreational facilities and transient lodging uses near the freeway, including quality recreational vehicle resorts, tennis clubs and amusements parks;

- Capitalize on area entertainment and recreational facilities, such as the Desert Sky Pavilion, Phoenix International Raceway, and Estrella Mountain Regional Park, to encourage visitors into Tolleson's 'Downtown Center' by coordinating local festivities with scheduled events;

- Capitalize on local employment base for support of Tolleson restaurants and stores through advertising and coordination of events with major employment centers' work shift and lunch schedules;

- Initiate the formation of an Intergovernmental Agreement (IGA) with cities located along the Southern Pacific Railroad, such as Mesa, Tempe, Phoenix, Avondale and Goodyear, to provide a winter season tourist train and local bus service, encouraging the uniqueness of each community as a tourist destination;

- Coordinate proposed tourist train/bus schedules with events in Tolleson's 'Downtown Center' and at the Desert Sky Pavilion, and encourage event 'packages;' e.g., total price includes tickets to entertainment event, train/bus transportation, and dinner or lunch in a Tolleson restaurant;

- Construct or rehabilitate a building near the Southern Pacific Railroad for use as a traveler/retail depot;

- Design the depot to compliment the 'Downtown Center' character to include a restaurant and retail business, and locate the depot in an area suitable for desirable pedestrian access, as well as local bus service for visitors and nearby industry employees' use;

- Develop a local 'lunch bus' route from major employment centers to Van Buren business corridor during lunch hours or other major work shift periods;

- Continue to encourage development of major industries in the Southern Pacific Railroad Corridor;

- Initiate coordination and development of 'outlet' retail stores with local food product industries in Tolleson;

- Initiate new or additional city taxes for commercial recreation, recreational vehicle parks, transient lodging, food and beverage services.

CHAPTER 4. COMMUNITY FACILITIES AND SERVICES

Tolleson's strong sense of community is reflected in its residents' satisfaction with municipal services, expressed in response to the Tolleson citizen questionnaire. The City of Tolleson provides fire, police, refuse collection, water and sewer services. It operates and maintains a library, park and community center. The municipal government participates in community group activities and partners with the local school districts to augment recreational services. Public education is provided by three school districts, area community colleges and Arizona State University West.

PUBLIC SAFETY SERVICES

Fire Protection:

Tolleson's Department of Safety Services is comprised of the Fire Department, Building Department, City-wide Safety and Loss Control Programs. The 15-employee Fire Department, augmented by 15 reserve members, is divided into three shifts to provide 24-hour, seven-day per week protection. At least one paramedic accompanies each shift which is supervised by a Captain. The Tolleson Fire Station, located at 92nd Avenue and Monroe as shown on the Community Facilities Map, houses two engines and one ladder tender. The average response time to emergencies is less than 5 minutes. The Fire Department responded to more than 1,800 calls in fiscal year 1993-94. The majority of the calls were for paramedic and basic life support services. The remainder included responses to vehicular accidents, fires and special duties. The Tolleson Fire Department is efficiently operated, as reflected in the cost-per-call comparison with other West Valley communities.

FIRE DEPARTMENT OPERATIONS AND COSTS, 1994

DEPARTMENT	# OF CALLS	COST PER CALL
Tolleson	1,809	$ 446
Glendale	12,868	$ 607
Laveen	934	$ 811
Peoria	4,855	$ 854
Phoenix	114,131	$ 867
Goodyear	682	$ 952
Sun City	1,910	$1,213

Projections to the year 2005, predict 2,500 calls per year. The Fire Department currently received a new engine to replace the previous one, borrowed from the City of Phoenix. An additional fire station and 9 firefighter/paramedic staff members will be necessary in the south side of Tolleson within the next 10 years to accommodate the anticipated industrial development.

Police Protection

The Tolleson Police Department consists of 19 full-time personnel, with 17 field force and 2 administrative staff members. The department was increased by 1 officer in 1996 under a federal grant, the COPS FAST program. Tolleson Police Department offers ample protection to residents, with a relatively high ratio of 4.1 officers per thousand resident population compared with other area cities.

POLICE DEPARTMENT" RATIOS: OFFICERS TO RESIDENTS, 1995-96

CITY	NUMBER OF OFFICERS	OFFICERS PER 1000 POPULATION
Tolleson	17	4.10
Goodyear	17	1.70
Avondale	37	1.70
Peoria	50	1.48
Glendale	235	1.33
Phoenix	960	0.89

It should be noted, however, that the ratios above do not consider persons in the community who are not residents. With more than 5,000 employees of major industries and almost 2,000 high school and elementary school students and staff, the population of Tolleson is almost tripled during typical work/school days.

The Tolleson Police Station, including a jail/holding facility, is housed at City Hall on Van Buren Street. The Police Department provides overnight detention services for Avondale, while Maricopa County provides animal control for Tolleson, with intergovernmental agreements. The Police Department received two new vehicles this year, for a total of 16. A bicycle patrol is being considered. Tolleson Justice Courts are located in the Tolleson Plaza across Van Buren Street from City Hall (see The Community Facilities Map).

WATER AND SEWER SERVICES

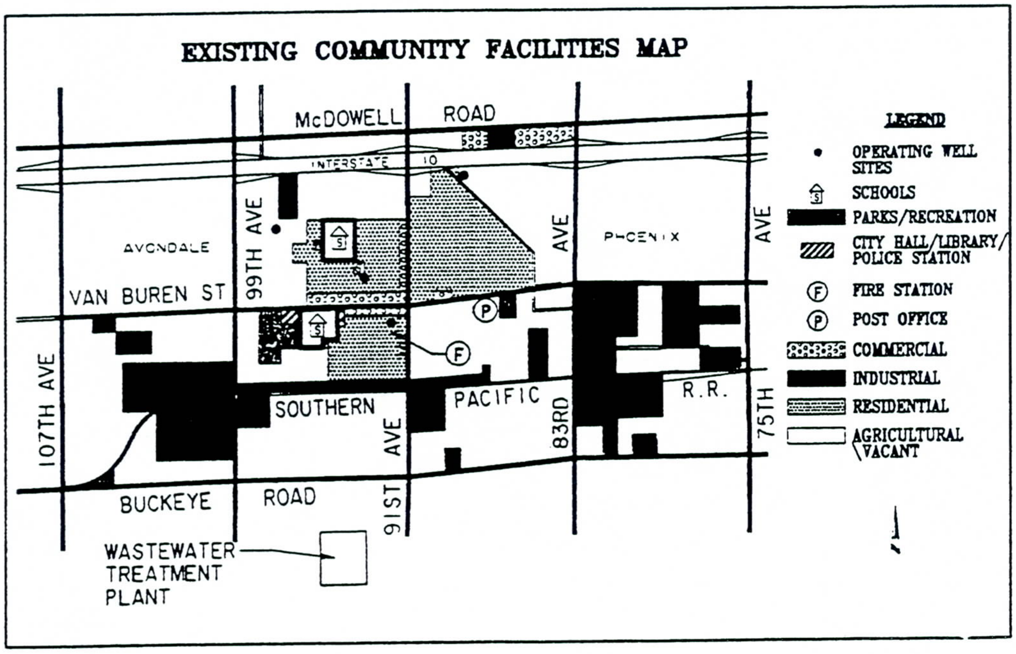
Water Supply and Delivery

In 1993, the residents of Tolleson passed a bond election for $4 million of capital improvements to the City's water system. This has resulted in the construction and installation of Well #8, with reservoir and water treatment facility at Roosevelt and 99th Avenue, giving the City almost 3.5 million gallons of total storage capacity. The bond passage is also funding the construction and installation of another water treatment system at Well #4, northeast of Tolsun Farms. This will allow minimal use and perhaps eventual closure of 3 older wells when the looping of Well Site #8 to Well Site #4 is completed, permitting more efficiencies of operations and costs. The location of Tolleson's operating wells #1, 3,4, 7 and 8 are shown on The Community Facilities Map.

There is concern over Tolleson's water quality being impacted by contamination of underground water found in the western area of Phoenix. The underground plume of chemical contaminants, such as PCE and TCE, appear to be flowing in a westerly direction. The City of Phoenix is limiting its ground water usage and using Salt River Project water and Central Arizona Project water from the Colorado River as a result. The Central Arizona Project water is not available to Tolleson as it lies wholly within the Salt River Project water franchise area. Tolleson is currently monitoring its wells and negotiating with the City of Phoenix for delivery of treated Salt River Project water to Tolleson. The Council is also pursuing possible agreements with southwest valley cities to cooperatively build their own treatment and delivery system of Salt River Project water.

Sewer Services

The Tolleson Wastewater Treatment Plant is located on 95th Avenue, a half mile south of Buckeye Road. The plant has a capacity of 17.5 million gallons per day and is currently treating approximately 13 million gallons per day. This capacity is shared by four entities: Peoria, Sun Land Beef, Sun City, and Tolleson. Tolleson's proportionate share of the expanded capacity in all probability will accommodate total development in Tolleson. Tolleson has committed 8.3 million gallons per day of treated effluent to be sold to the Palo Verde Nuclear Generating Station. This allows Tolleson to use surplus effluent for future economic development incentives or for irrigation of community facilities, or as part of a comprehensive water resources program.



LIBRARY, RECREATION AND SCHOOLS

Library and Community Center

The City of Tolleson operates a library located within the City Hall complex on West Van Buren Street. The library occupies approximately 4,000 square feet and is adjacent to the Esther Augulo Community Center. The library maintains 18,000 volumes and coordinates with the Interlibrary Loan program to procure additional books. The library's InfoTrac Computer Program produces reference information from past articles of magazines and newspapers. The library provides programs and activities for preschoolers and mothers. The Community Center schedules a meeting room for programs, such as tax preparation for seniors, Sister City, the Chamber of Commerce, Women's Club, and Lion's Club, and functions as the Tolleson Senior Center and Community Action Program office. Tolleson's Senior Center offers daily activities to residents over 60. Activities include games, crafts, a noon meal, parties, trips and an annual depression screening. The Tolleson Community Action Program coordinates with the Salvation Army and other non-profit organizations in providing food and services to those in need.

Recreation

Major recreational facilities are centered along the south side of Van Buren Street, near City Hall. Cowden Park, a City park, is located just south of City Hall and provides space for leisure time activities. It is developed with picnic tables, playground equipment and a large group ramada. Cowden Park is adjacent to Tolleson Union High School recreational facilities to the west. These include tennis and racquetball courts, and ballfields. The sports facilities of Tolleson Unified High School District include a swimming pool and football/track field with bleachers. The facilities are used by Tolleson residents through an IGA between the City and Tolleson Unified High School District.

Another recreational facility is in Tolleson's northern residential area. Tolleson Elementary School, at 93rd Avenue and Garfield Street, contains ballfields and playgrounds. On 95th Avenue, between Pierce and Roosevelt, is a city-owned park of approximately 2 acres, with a ramada and picnic tables. Basketball courts are planned for construction in 1996/97. The City also owns a proposed park site south of Van Buren at 86th Avenue. It contains approximately 8.6 acres and is currently undeveloped.

Tolleson Boys and Girls Club, located at 92nd Avenue and Washington Street, offers after-school, evening and Saturday programs to Tolleson's youth. The programs range from help with school work, to arts and crafts, to games and sports. An intergovernmental agreement between the City and the Tolleson Union High School and Tolleson Elementary School Districts provide summer recreation programs, targeting 13- to 18-year olds. Running from June through mid-August, the program consists of basketball, volleyball, weight-lifting, aerobics, swimming, and tennis.

Schools and Colleges

The Tolleson community is served by the Tolleson Union High, Tolleson Elementary and Littleton Elementary School Districts. The Tolleson Union High School District includes a geographic area of approximately 100 square miles, encompassing several other communities in addition to Tolleson. The Tolleson Union High School, located at 94th Avenue and Van Buren, has a current enrollment of approximately 1,500 students. The passage of a district bond election in May 1995 will provide an auditorium, hi-tech center, fine arts facility, all-weather track, and upgrade retrofits to the Tolleson Union High school campus in an amount of $7.5 million or more, depending on assessed valuations. The High School District students score above the state and national averages on the SAT and ACT tests. The dropout rate has declined from 15% to 10%, and the graduation rate has increased from 50% to 67%. District officials project that Tolleson Union High School will be at enrollment capacity of 1,750 students some time after the turn of the century.

Tolleson Elementary School District serves all but a small portion of Tolleson lying west of 99th Avenue, which is served by the Littleton Elementary School District. The Tolleson Elementary School is located at 93rd Avenue and Garfield Street, and consists of grades K through 8. Its current enrollment is 1,068, an increase of 9% over the past year. Tolleson Elementary School expects to be at its 1,400 student capacity within the next few years. Recently, the Tolleson Elementary School District consolidated three school sites into the one new facility, leaving properties near the district offices and at 93rd Avenue and Taylor Street eligible for sale and reuse. The Taylor Street property will be renovated and reused as an Alternative School by the District. The property at Monroe and 93rd Avenue is planned to be sold and used for senior housing and single-family home lots.

Estrella Community College, at Dysart and Thomas Roads in the Avondale/Litchfield Park area, is the closest college to Tolleson in the Maricopa Community College District. Other colleges in the district are Glendale Community College, at Olive and 59th Avenue, Phoenix College at Thomas and 15th Avenue, and Rio Salado College in downtown Phoenix.

Arizona State University provides a campus in the western valley at Thunderbird and 51st Avenue. Other institutions of higher education in the western region include American Graduate School of International Management, Grand Canyon College, Ottawa University, and the Metro Tech Vocational Institute of Phoenix.

Issues: Public Safety Services

- Community desires to maintain adequate police and fire departments;
- Community concerned about future occurrences of graffiti, gang and other teenage-related crimes;
- Community requests mitigation of litter and noise problems.

Goal:

> ***Maintain Tolleson's sense of a secure community through continued high-quality law enforcement and fire safety services.***

Strategies:

- Continue personnel training and upgrading of equipment in the Police and Fire Departments;
- Plan for the funding of another fire station and staff in the area south of the Southern Pacific Railway when warranted by substantial industrial development;
- Maintain laws and ordinances for the prevention of gangs and teenage-related crimes, such as youth curfews, restrictions on spray paint sales, and graffiti control measures;
- Increase enforcement of anti-litter and noise ordinances through additional street lighting and regular patrolling of residential areas.

Issues: Water and Sewer Services

- Community concerned over existing and future quality of Tolleson's water;
- Residents request additional economic and community benefits from surplus-treated effluent.

Goal:

> ***Protect and improve water quality and expand reuse of effluent.***

Strategies:

- Continue improvements to the existing water system with the water improvement bond and other sources;
- Coordinate efforts with other governmental jurisdictions for remedies to contamination and protection of ground water;

- Investigate alternative water sources, such as Salt River Project, available to Tolleson in lieu of ground water;

- Initiate cooperative effort with west valley communities for possible co-owned water treatment and delivery system of Salt River Project water;

- Provide surplus-treated effluent as an economic incentive to developers of golf course/tourist lodging facilities, amusement parks, and recreation centers;

- Plan for design and funding of effluent mains for irrigation of landscaped pedestrian routes and parks and for creation of a City "fishing lake."

Issues: Recreation and Schools

- Community desires more variety of parks and recreational activities;

- Residents request more direct involvement with the school districts for improvements to student education.

Goal:

Provide enhanced citywide recreation and more responsive school system.

Strategies:

- Plan for design and funding of a continuous pedestrian/bike path network linking parks, schools and residential neighborhoods throughout Tolleson;

- Plan for design and funding of a community fishing lake, picnic and playground park at the City-owned park site on Van Buren and 86th Avenue;

- Encourage commercial recreational facilities, such as a golf course or amusement park, with City incentives to developers who will allow Tolleson children periodic free entry or athletic training;

- Form a committee of parents to request new parent-involvement programs at local schools to concentrate District objectives on lowering dropout rates, improving national test scores and job preparation skills;

- Establish a task force of parents, business owners, school district board members and staff to create extra-curricular youth programs through expansion of recreational and educational activities, part-time jobs, and training opportunities;

- Establish additional activities for youth of various ages, such as Boy's & Girl's Scouts, Explorers Club, and 'service learning' classes by young adults;

- Organize fund-raising campaigns, operated by Tolleson youth, such as recycling programs, to support their extra activities.

__Issues: Leadership and Communication__

- Community needs more public participation to accomplish goals;

- Residents want regular, continuous information on City projects, new developments and activities.

__Goal:__

Promote leadership and citizen involvement.

__Strategies:__

- Hold a 'Town Forum' at least every five years for identification of major issues and priorities by a wide cross-section of Tolleson residents and business people;

- Start a community leadership program for high school students and adults by investigating similar programs in other cities;

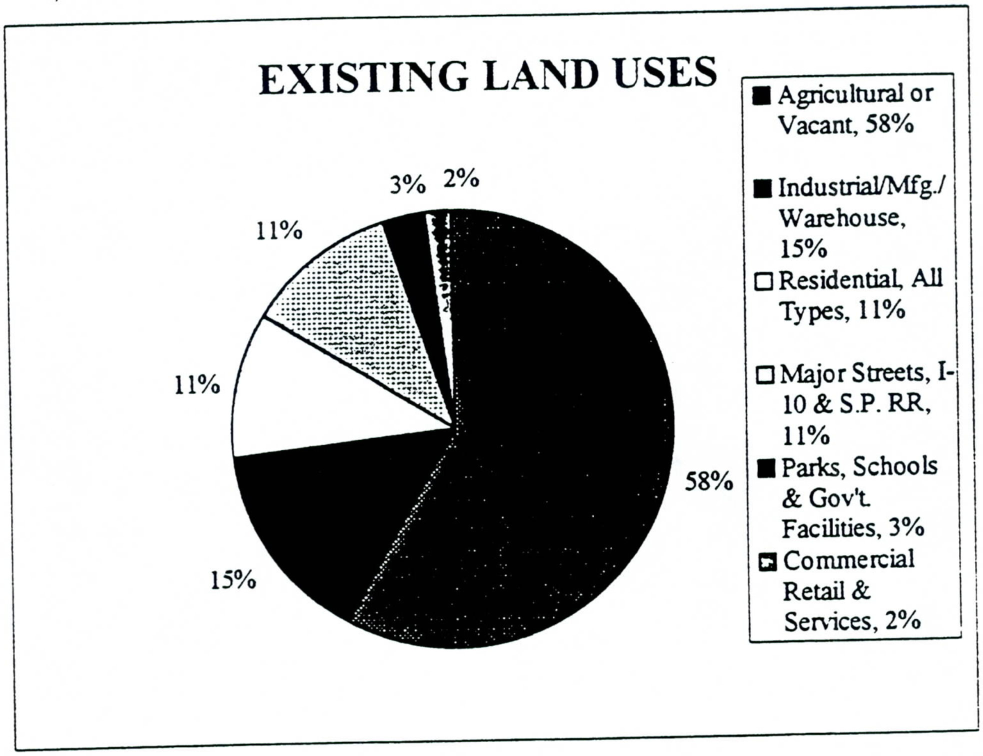
- Send out the 'Tolleson Flyer,' or other colorful brochure, on a monthly basis with information on City department projects, new buildings and planned developments, recreation, social and school activities;

- Consider adding a citizens' column and/or 'Letters to the City' to stimulate reader interest.

CHAPTER 5. LAND USE

Key to Tolleson's unique character is the retention of its compact land use pattern. The City's early development centered on commercial activity along Van Buren Street with residential neighborhoods to the north and south. Homes are located within a half mile of the Van Buren central business core. Schools, parks, recreation facilities, and government offices are also contained within this approximate one-half square mile of compact urban form west of 91st Avenue.

As the City expanded, new residential areas developed to the east within the one-half mile radius of Van Buren Street. Major industrial employment centers located a half mile to two miles south, east and west of the Van Buren central business core. Many large parcels of land are currently in agricultural use or undeveloped. Existing land use proportions are shown in the chart below.

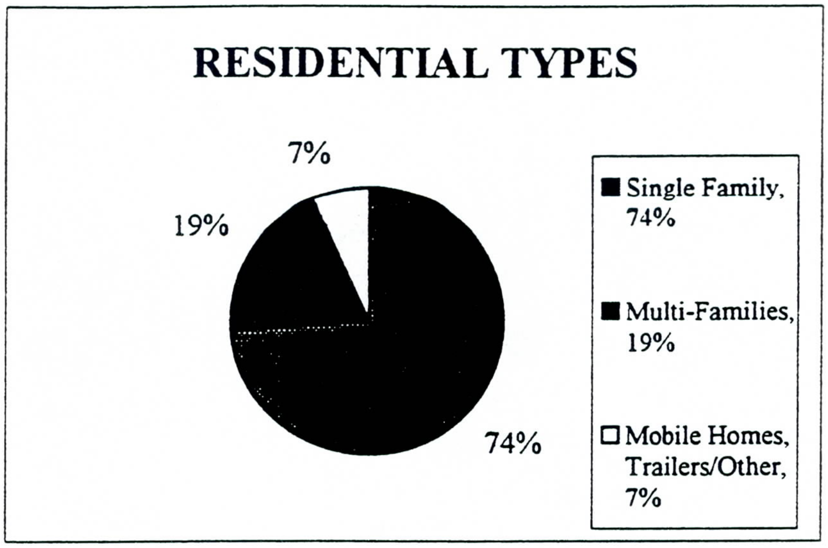


Percentages of land uses are approximate

Tolleson is continuing to enhance its sense of community through protection of existing neighborhoods and maintenance of its compact land use form in new developments. With incentives and buffering techniques, new residential areas will locate close to existing municipal services, schools and recreational facilities. Commercial businesses, which provide for neighborhood needs, will expand the central business core. Tourist-related commercial uses and industrial employment centers will orient to the major transportation corridors in Tolleson.

RESIDENTIAL USES

The majority of residential uses in Tolleson are single-family homes on individual lots. Of the 1,359 total dwelling units counted in the 1990 U.S. Census, 74%, or 1,009, are single-family homes. Nineteen percent (259) are multi-family units and 7% (91) are categorized as mobile homes, trailers and other types. Values for more than 50% of the single-family homes are between $40,000 and $75,000. Approximately 27% of the homes were valued below $40,000 and another 22% were above $75,000.



The number of housing units in Tolleson reflected in the 1995 Mid-Decade U.S. Census shows almost no increase since 1990. New homes in the recently developed Villa Rica Subdivision were not occupied at the time of the census count. Thirty-five single-family homes have been built in Villa Rica. Thirty-two are sold, 3 are model homes, and 17 lots remain in the first phase of 49 homes. The second phase will provide a total build-out of 132 new homes. Lots vary from urban size (7,200 square feet) to half-acre size (18,000 square feet).

A comparison of west valley cities population, housing and vacancy rates is shown in the chart below. Although Tolleson's new housing units are not shown in the 1995 census, the demand for housing is apparent in the decrease of the vacancy rate. Tolleson's vacancy rate in 1990 was 10.5% (143 units); in 1995, it dropped to 7.2% (98 units).

	1990		1995		
CITY	POPULATION	HOUSING UNITS	POPULATION	HOUSING UNITS	VACANCY RATE
Avondale	16,169	5,579	21,766	7,195	8.2%
Goodyear	6,258	1,607	8,979	2,742	13.1%
Litchfield Park	3,303	1,433	3,659	1,509	7.0%
Tolleson	4,434	1,359	4,261	1,360	7.2%

Existing multi-family uses are apartment complexes located on 96th Avenue north of Van Buren, on 95th Avenue and Baden Street and along Roosevelt at 93rd Avenue. Planned mixed-use residential developments are located near the southeast corner of 91st Avenue and Van Buren. The proposed development contains two tracts for multi-family uses. One tract, located on 91st Avenue between Adams and Jefferson Streets is approximately 16 acres. It is zoned R-2 and planned for both apartments and patio homes or townhouses. The other tract is located on Van Buren Street, west of 87th Avenue. This tract contains approximately 14.5 acres and is also zoned R-2. It is planned for townhouses or condominiums. Both developments will contain perimeter and internal greenbelts, trails, swimming pools and tennis courts. The Tolleson Zoning Ordinance applies residential densities through specific site plan approval processes.

Another area proposed for multi-family development is located along the west side of 96th Avenue just north of the Sundancer Apartments. The proposed development will contain 142 condominium units on approximately 6.5 acres.

A senior housing complex is proposed for reuse of half of the former elementary school site on Monroe between 92nd Drive and 93rd Avenue. It will consist of 41 apartments for federally assisted senior citizens, and be operated by Mercy Housing, a non-profit corporation.

The remainder of the former school site is proposed for subdivision. It will be divided into approximately eight single-family lots, fronting on 92nd Drive and 93rd Avenue. Including the proposed eight lots, there are approximately 40 single-family lots in existing neighborhoods which are appropriate for infill or redevelopment for new homes.

Totaling the proposed multi-family developments at 91st Avenue and Van Buren Street and at 96th Avenue, the senior citizen apartments at Monroe, the infill/redevelopment lots and the Villa Rica Subdivision lots, there are over 700 additional dwelling units proposed for Tolleson.

COMMERCIAL AND INDUSTRIAL USES

While residential land uses increased in area approximately 3% over the past 15 years, the largest growth in land use was in industrial and commercial areas. Industrial and commercial uses, including warehouse, distribution, manufacturing, retail, restaurants and lodging more than doubled during the same period.

Newer commercial uses include K-Mart discount store, EconoLodge Motel, Circle K convenience store, Jack-in-the-Box, Waffle House, Sonic Burger and Subway restaurants, and the Tolleson Plaza shopping center. The commercial uses are located on McDowell Road between 83rd and 91st Avenue, and along Van Buren between 91st and 96th Avenues.

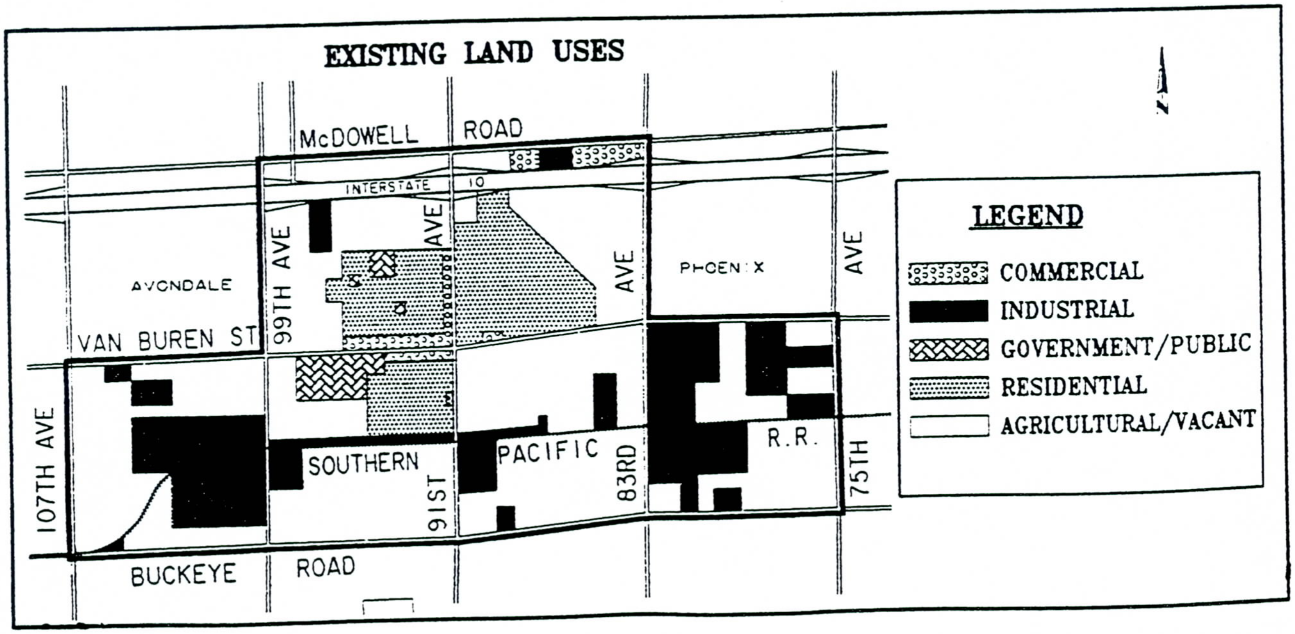
Other larger areas zoned for commercial use include the southeast corner of 91st Avenue and Van Buren, the northwest and southwest corners of 83rd Avenue and Van Buren, southwest corner of I-10 and 83rd Avenue, the south side of McDowell east of 91st Avenue, the southeast corner of McDowell and 99th Avenue, and the east side of 99th Avenue south of I-10 to Van Buren.

Preliminary plans reflect a 17-acre shopping center at the southeast corner of 91st Avenue and Van Buren Street. The proposed center includes major retail stores and individual shops. Adjacent parcels along Van Buren Street are proposed for a convenience commercial center and a neighborhood commercial center on each of two 4-acre tracts.

A variety of industrial uses including automotive, agri-related and manufacturing business now occupy most of Tolleson's eastern square mile, bounded by Van Buren Street, 75th Avenue, Buckeye Road and 83rd Avenue. Tolleson's western section between 107th and 99th Avenues is approaching 50% occupancy by industrial users, prominently Smith's, Albertson's and Power Packaging (Snapple). Lisanti Foods is beginning construction at 104th Avenue and Van Buren, near the first of four warehouses/distribution buildings by the Mack Company. Remaining undeveloped parcels, in both the eastern and western square miles south of Van Buren, are primarily proposed and zoned for industrial development.

Other major industrial uses are located along the Southern Pacific Railway between 99th and 83rd Avenues. These include Borden Creamette, Bay State Milling and Sun Land Beef. North of the railroad, between 86th and 83rd Avenues, is the Mission Business Park. Price/Costco and Stone Container are major tenants of the Mission Business Park. Remaining properties south of the railroad are proposed and zoned for industrial and commercial usage.

Almost one-half mile north of Van Buren Street, between 99th and 95th avenues, industrial use has begun with the Rickett-Coleman Company located on Roosevelt, east of 99th Avenue. Over 70 acres are available for industrial development between the I-10 freeway and Pierce Street in this area. Additionally, land on the south side of McDowell Road, running west approximately three-quarters of a mile from 91st Avenue, is zoned for industrial use. Parker-Hanniflin Fuel Products Division is located on McDowell about one-half mile west of 83rd Avenue. Land on the west side of 83rd Avenue, between I-10 and Van Buren Street to Tolsun Farms Subdivision, is also zoned for industrial usage.



Issues: Land Uses

- Residents desire to maintain Tolleson's small town atmosphere.
- Residents fear loss of current agricultural field protection to their neighborhoods by future industrial encroachment.
- Community needs more variety and better quality housing.
- Residents want expansion of commercial areas for retail, entertainment and recreational enterprises.
- Community desires improved visual appearance and image for Tolleson.

Goal:

Maintain Tolleson's sense of community through the continuation of compact land use patterns with quality development and buffering.

Strategies:

- Encourage the development of residential areas in close proximity to neighborhood commercial businesses;
- Encourage a mix of medium and higher residential densities near schools, parks and the Van Buren business core;
- Use zoning incentives such as variable lot and street size, building setbacks and density bonuses for development of 'close neighborhoods' on larger parcels, which include and integrate varied housing types with open space, recreational amenities and neighborhood businesses;
- Encourage the building of apartments for senior citizens and the disabled within close proximity to the Van Buren business core and transit route, such as on the former elementary school site;
- Require new developments to include continuous tree-lined sidewalks and bicycle routes on all major streets;
- Require landscaped buffers and screening walls between non-residential uses and residential areas;
- Create open space buffers, such as major recreational facilities and greenbelts between residential and industrial or major commercial use areas, through incentives such as availability of surplus effluent;
- Encourage redevelopment, infill and expansion of specialty retail and service businesses in the Van Buren Street business core and on 91st Avenue;

- Encourage tourist-oriented and major commercial recreational businesses near I-10 at 91st and 83rd Avenues;

- Encourage major commercial retailers, such as groceries and discount stores on 99th Avenue;

- Protect the residential areas by controlling the access and location of any new streets to prevent their use for through traffic between Van Buren and Roosevelt and between 91st and 99th Avenues;

- Encourage the development of commercial parcels along Van Buren, between 91st and 83rd Avenues which design buildings compatible with the 'Main Street', pedestrian-oriented Van Buren business core, locating buildings near the street sidewalks and parking in the rear and sides;

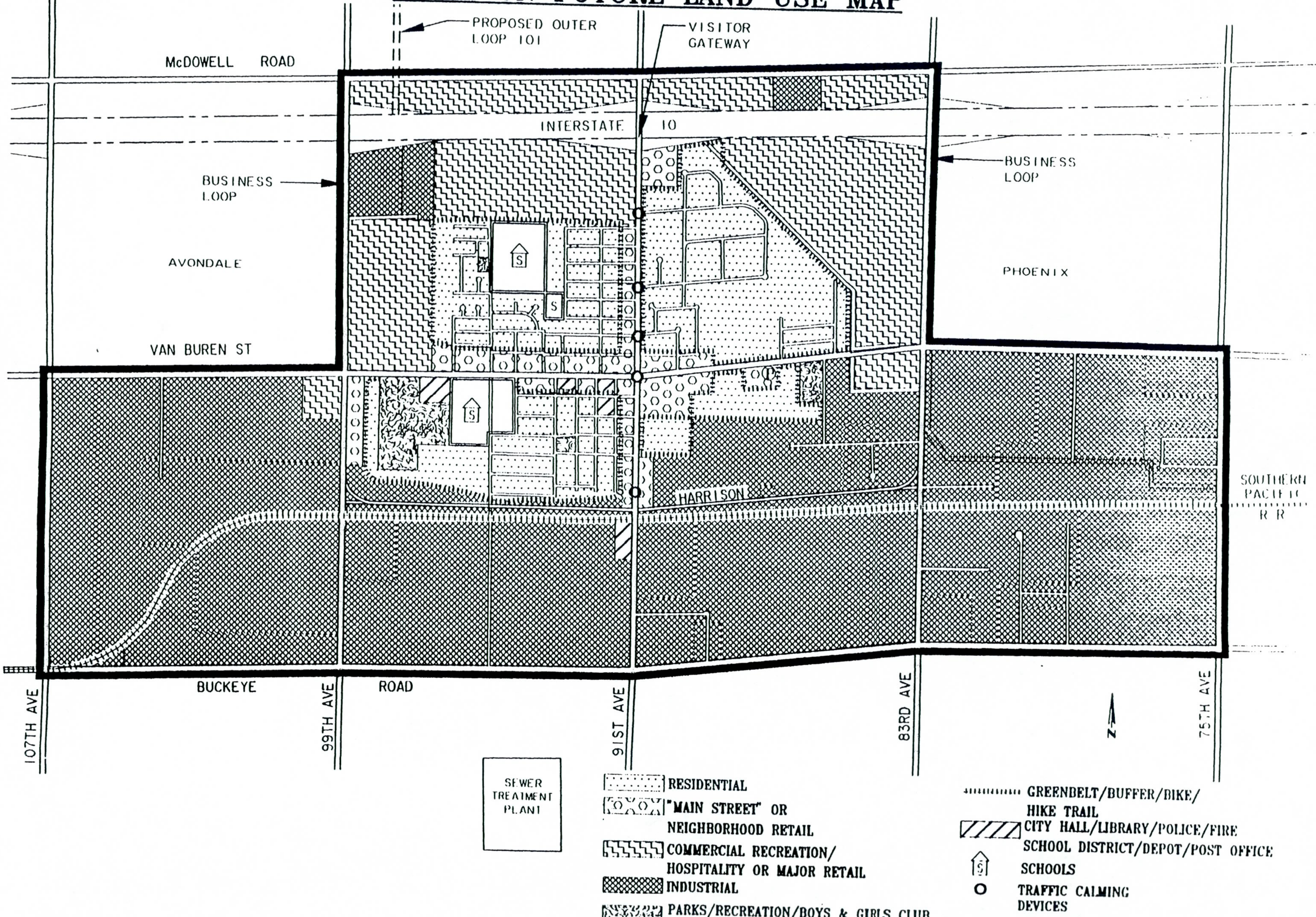
- Promote industrial/warehouse business on undeveloped properties near the southern Pacific Railway core;

- Limit business uses to retail, office, and research-development firms with maximum height of two stories, landscaped buffer areas and screening walls in the areas near existing and planned residential neighborhoods;

- Enhance the City's appearance by planting and maintaining additional landscaping to create an effect of continuous city-wide, tree-lined sidewalks;

- Protect, replace and install prominent street trees, such as pecans, and other landscaping along 75th, 83rd, 91st, 99th and 107th Avenues and Van Buren Street.

TOLLESON FUTURE LAND USE MAP



APPENDIX E-7: Excerpts from Southwest Valley Transportation Study Final Report

APPENDIX E-7: Excerpts from Southwest Valley Transportation Study Final Report

TABLE A-1
SOUTHWEST VALLEY FREEWAY SEGMENT INVENTORY
EXISTING CONDITIONS (YEAR 1996)

Revised August 1996

Roadway	From-To	Location	Responsible Agency	Classification	LOS E Capacity	Existing ADT	Estimated Daily LOS
I-10	83rd - 91st Ave.	Tolleson	ADOT	8LN Freeway*	169,200	70,000	B
	91st - 99th Ave.	Tolleson	ADOT	6LN Freeway	126,900	67,000	C
	99th - 115th Ave.	Avondale	ADOT	6LN Freeway	126,900	49,000	B
	115th Ave. - Dysart	Avondale	ADOT	6LN Freeway	126,900	52,000	B
	Dysart - Litchfield	Goodyear	ADOT	4LN Freeway	80,800	49,000	C
	Litchfield - Estrella Pkwy.	Goodyear	ADOT	4LN Freeway	80,800	28,000	B
	Estrella - Cotton	Goodyear	ADOT	4LN Freeway	80,800	23,000	B
	Cotton - Jackrabbit	Goodyear	ADOT	4LN Freeway	80,800	24,000	B
	Jackrabbit - Miller	Buckeye/ County	ADOT	4LN Freeway	80,800	21,000	A
	Miller - SR 85	County	ADOT	4LN Freeway	80,800	20,000	A
	SR 85 - Palo Verde	County	ADOT	4LN Freeway	80,800	18,000	A
	Palo Verde - 339th Ave.	County	ADOT	4LN Freeway	80,800	17,000	A

* Includes HOV lanes.

Source: Maricopa County Department of Transportation; BRW, Inc.; October 1995.

TABLE A-2
SOUTHWEST VALLEY ARTERIAL/COLLECTOR SYSTEM INVENTORY
EXISTING CONDITIONS (YEAR 1996)

Revised August 1996

Roadway	From-To	Location	Responsible Agency	Classification	LOS D Capacity	Existing ADT	Estimated Daily LOS*
McDowell Rd.	Cotton - Citrus	Goodyear	County	2LN Minor Collector	6,400	2,000	A
	Citrus - Perryville	Goodyear	County	2LN Minor Collector	6,400	1,000	A
	Perryville - Jackrabbit	County	County	2LN Minor Collector	6,400	700	A
	Jackrabbit - Airport	County	County	2LN Minor Collector	6,400	800	A
Van Buren St.	67th Ave. - 75th Ave.	Phoenix	Phoenix	2LN Minor Collector	6,400	5,400	C
	75th Ave. - 83rd Ave.	Phoenix	Phoenix	2LN Minor Collector	6,400	4,100	A
	83rd - 91st Ave.	Tolleson	Tolleson	4LN Minor Arterial	25,000	1,900	A
	91st - 96th Ave.	Tolleson	Tolleson	4LN Minor Arterial	25,000	3,000	A
	96th - 99th Ave.	Tolleson	County	4LN Minor Arterial	25,000	3,000	A
	99th - 107th Ave.	Tolleson	County	2LN Minor Collector	6,400	2,800	A
	107th - 115th Ave.	County	County	2LN Minor Collector	6,400	4,000	A
	115th Ave. - El Mirage Rd.	Avondale	County	4LN Minor Arterial	25,000	3,600	A
	El Mirage Rd. - Dysart	Avondale	Avondale/ County	4LN Minor Arterial	25,000	3,600	A
	Dysart - Litchfield	Goodyear	Goodyear	4LN Minor Arterial	25,000	2,000	A
	Litchfield - Bullard	Goodyear	Goodyear	2LN Minor Collector	6,400	2,200	A
	Bullard - Estrella Pkwy.	Goodyear	Goodyear	2LN Minor Collector	6,400	2,200	A
	Estrella Pkwy. - Sarival	Goodyear	County	2LN Minor Collector	6,400	2,000	A
	Sarival - Cotton	Goodyear	County	2LN Minor Collector	6,400	1,600	A
	Cotton - Citrus	Goodyear	County	2LN Minor Collector	6,400	1,000	A
	Citrus - Perryville	County	County	2LN Minor Collector	6,400	1,000	A

TABLE A-2
SOUTHWEST VALLEY ARTERIAL/COLLECTOR SYSTEM INVENTORY
EXISTING CONDITIONS (YEAR 1996)

Revised August 1996

Roadway	From-To	Location	Responsible Agency	Classification	LOS D Capacity	Existing ADT	Estimated Daily LOS*
Van Buren St.	Perryville - Jackrabbit	Buckeye	County	2LN Minor Collector	6,400	600	A
	Jackrabbit - Tuthill	Buckeye	Buckeye	2LN Minor Collector	6,400	500	A
MC 85	67th Ave. - 75th Ave.	Phoenix	Phoenix	4LN Minor Arterial	25,000	9,000	A
	75th Ave. - 83rd Ave.	Phoenix	Phoenix	4LN Minor Arterial	25,000	8,500	A
	83rd Ave. - 91st Ave.	Phoenix	Phoenix	4LN Minor Arterial	25,000	7,700	A
	91st Ave. - 99th Ave.	Tolleson	County	4LN Minor Arterial	25,000	5,000	A
	99th Ave. - 107th Ave.	Tolleson	County	4LN Minor Arterial	25,000	4,500	A
	107th Ave. - El Mirage Rd.	Avondale	County/ Avondale	4LN Minor Arterial	25,000	4,500	A
	El Mirage - Dysart	Avondale	County/ Avondale	4LN Minor Arterial	25,000	4,600	A
	Dysart - Litchfield	Avondale	Avondale	4LN Minor Arterial	25,000	5,000	A
	Litchfield - Bullard	Goodyear	County/ Goodyear	2LN Rural Highway	11,200	7,400	D
	Bullard - Estrella Pkwy.	Goodyear	County	2LN Rural Highway	11,200	3,000	C or better
	Estrella Pkwy. - Cotton	Goodyear	County	2LN Rural Highway	11,200	3,800	C or better
	Cotton - Jackrabbit	Goodyear/ County	County	2LN Rural Highway	11,200	3,000	C or better
	Jackrabbit -Watson	County	County	4LN Minor Arterial	25,000	5,200	A
	Watson - Apache	County	County	4LN Minor Arterial	25,000	5,000	A
	Apache - Miller	Buckeye	Buckeye	4LN Minor Arterial	25,000	4,000	A
	Miller - SR 85	County	County	2LN Rural Highway	11,200	3,100	C or better

TABLE A-2
SOUTHWEST VALLEY ARTERIAL/COLLECTOR SYSTEM INVENTORY
EXISTING CONDITIONS (YEAR 1996)

Revised August 1996

Roadway	From-To	Location	Responsible Agency	Classification	LOS D Capacity	Existing ADT	Estimated Daily LOS*
Narramore Rd.	Airport - Dean	County	County	2LN Minor Collector	6,400	500	A
	SR 85 - Johnson	County	County	2LN Minor Collector	6,400	500	A
Arlington Rd.	Rainbow Valley Rd. - Airport Rd.	County	County	2LN Minor Collector	6,400	1,000	A
Ray Rd.	Rainbow Valley Rd. - Airport Rd.	County	County	2LN Minor Collector	6,400	2,200	A
Williamsfield Rd.	Cotton Lane - Rainbow Valley Rd.	Goodyear	Goodyear	2LN Minor Collector	6,400	2,000	A
NORTH - SOUTH STREETS							
75th Ave.	McDowell - Van Buren	Phoenix	Phoenix	2LN Major Collector	7,900	7,100	D
	Van Buren - Buckeye	County	County	2LN Major Collector	7,900	4,500	A
	Buckeye - Lower Buckeye	Phoenix	Phoenix	2LN Major Collector	7,900	2,000	A
83rd Ave.	Thomas - McDowell	Phoenix	Phoenix	6LN Principal Arterial	45,000	17,500	A
	McDowell - I-10	Phoenix	Phoenix	4LN Minor Arterial	25,000	1,900	A
	I-10 - Van Buren	Phoenix	Phoenix	2LN Minor Collector	6,400	1,900	A
	Van Buren - MC 85	Tolleson	Tolleson	4LN Minor Arterial	25,000	4,400	A
	MC 85 - Lower Buckeye	Phoenix	Phoenix	2LN Minor Collector	6,400	2,200	A
91st Ave.	Thomas - McDowell	County	Phoenix	4LN Minor Arterial	25,000	11,000	A
	McDowell - Van Buren	Tolleson	Tolleson/ County	2LN Minor Collector	25,000	8,400	A
	Van Buren - MC 85	Tolleson	County	4LN Minor Arterial	25,000	8,000	A
	MC 85 - Lower Buckeye	Phoenix	Phoenix	2LN Minor Collector	6,400	1,700	A

TABLE[illegible]
SOUTHWEST VALLEY ARTERIAL/COL[illegible]TOR SYSTEM INVENTORY
EXISTING CONDITIONS (YEAR 1996)

Revised August 19[illegible]

Roadway	From-To	Location	Responsible Agency	Classification	LOS D Capacity	Existing ADT	Estimated Daily LOS*
99th Ave.	Camelback Rd. - Indian School Rd.	Phoenix	County	4LN Minor Arterial	25,000	24,000	D
	Indian School Rd. - Thomas Rd.	Phoenix	County	4LN Minor Arterial	25,000	23,100	D
	Thomas Rd. - McDowell Rd.	Phoenix	County	4LN Minor Arterial	25,000	12,400	A
	McDowell - Van Buren	Tolleson	Tolleson	4LN Minor Arterial	25,000	8,100	A
	Van Buren - MC 85	Tolleson	Tolleson	4LN Minor Arterial	25,000	5,800	A
	MC 85 - Lower Buckeye	Phoenix	Phoenix	2LN Minor Collector	6,400	2,800	A
107th Ave.	Camelback Rd. - Indian School Rd.	Phoenix	Phoenix	2LN Minor Collector	6,400	6,400	D
	Indian School - Thomas	Avondale	Avondale	2LN Minor Collector	6,400	5,600	C
	Thomas - McDowell	Avondale	County	2LN Minor Collector	6,400	4,000	A
	McDowell - Van Buren	Avondale	County	2LN Minor Collector	6,400	1,500	A
	Van Buren - MC 85	Avondale	County	2LN Minor Collector	6,400	2,100	A
	MC 85 - Lower Buckeye	Phoenix	Phoenix	2LN Minor Collector	6,400	1,900	A
	Lower Buckeye - Broadway	Phoenix	Phoenix	2LN Minor Collector	6,400	1,200	A
107th Ave.	Broadway - Southern	Phoenix	Phoenix	2LN Minor Collector	6,400	1,900	A
115th Ave.	Thomas - McDowell	Avondale	County	2LN Minor Collector	6,400	3,400	A
	McDowell - Van Buren	County	County	2LN Minor Collector	6,400	3,900	A
	Van Buren - MC 85	Avondale	County	2LN Minor Collector	6,400	3,600	A
	MC 85 - Lower Buckeye	Avondale	County	4LN Minor Arterial	25,000	3,800	A
	Lower Buckeye - Broadway	County	County	4LN Minor Arterial	25,000	3,000	A

TABLE A-3
SOUTHWEST VALLEY ROADWAY SEGMENT INVENTORY
YEAR 2006 CONDITIONS WITH 2006 SYSTEM PLAN

Revised August 1996

Roadway	From-To	Location	Agency	Classification	LOS D Capacity	2005 ADT	Estimated Daily LOS	Project Level*
75th Ave.	MC 85 - Broadway	Phoenix	Phoenix	2LN Minor Collector	6,400	4,600	B	None
83rd Ave.	Thomas - McDowell	Phoenix	Phoenix	6LN Principal Arterial	45,000	23,700	A	None
	McDowell - Van Buren	Phoenix	Phoenix	6LN Principal Arterial	45,000	11,700	A	Local
	Van Buren - MC 85	Tolleson	Tolleson	4LN Minor Arterial	25,000	3,200	A	None
	MC 85 - Lower Buckeye	Phoenix	Phoenix	2LN Minor Collector	6,400	500	A	None
	Lower Buckeye - Broadway	Phoenix	Phoenix	2LN Minor Collector	6,400	100	A	None
91st Ave.	Thomas - McDowell	County	Phoenix	4LN Minor Arterial	25,000	5,400	A	None
	McDowell - Van Buren	Tolleson	County	4LN Minor Arterial	25,000	3,800	A	Subregional
	Van Buren - MC 85	Tolleson	County	4LN Minor Arterial	25,000	6,000	A	None
	MC 85 - Lower Buckeye	Phoenix	Phoenix	2LN Minor Collector	6,400	900	A	None
	Lower Buckeye - Southern	Phoenix	Phoenix	2LN Minor Collector	6,400	2,100	A	None
99th Ave.	Camelback Rd. - Indian School Rd.	Phoenix	County	4LN Minor Arterial	25,000	7,200	A	None
	Indian School Rd. - Thomas Rd.	Phoenix	County	4LN Minor Arterial	25,000	6,900	A	None
	Thomas Rd. - McDowell Rd.	Phoenix	County	4LN Minor Arterial	25,000	8,200	A	None
	McDowell - Roosevelt	Tolleson	Tolleson	4LN Minor Arterial	25,000	4,400	A	None
	Roosevelt - Van Buren	Tolleson	Tolleson	4LN Minor Arterial	25,000	4,400	A	None
	Van Buren - MC 85	Tolleson	Tolleson	4LN Minor Arterial	25,000	2,600	A	None
	MC 85 - Broadway	Phoenix	Phoenix	2LN Minor Collector	6,400	1,500	A	None
	Broadway - Southern	Phoenix	Phoenix	2LN Minor Collector	6,400	-	-	None

TABLE A
SOUTHWEST VALLEY ROADWAY [illegible]MENT INVENTORY
YEAR 2006 CONDITIONS WITH 2006 SYSTEM PLAN

Revised August 1996

Roadway	From-To	Location	Agency	Classification	LOS E Capacity	2005 ADT	Estimated Daily LOS	Project Level*
I-10	83rd - 91st Ave.	Tolleson	ADOT	8LN Freeway	169,200	-	-	None
	91st - 99th Ave.	Tolleson	ADOT	6LN Freeway	126,900	126,100	E	None
	99th - 115th Ave.	Avondale	ADOT	6LN Freeway	126,900	91,800	D	None
	115th Ave. - Dysart	Avondale	ADOT	6LN Freeway	126,900	87,700	D	None
	Dysart - Litchfield	Goodyear	ADOT	4LN Freeway	80,800	69,400	E	None
	Litchfield - Estrella Pkwy.	Goodyear	ADOT	4LN Freeway	80,800	56,300	D	None
	Estrella - Cotton	Goodyear	ADOT	4LN Freeway	80,800	44,600	C	None
	Cotton - Jackrabbit	Goodyear	ADOT	4LN Freeway	80,800	37,600	C	None
	Jackrabbit - Miller	Buckeye/ County	ADOT	4LN Freeway	80,800	36,400	C	None
	Miller - SR 85	County	ADOT	4LN Freeway	80,800	31,600	B	None
	SR 85 - Palo Verde	County	ADOT	4LN Freeway	80,800	24,600	B	None
	Palo Verde - 339th Ave.	County	ADOT	4LN Freeway	80,800	21,200	A	None

Roadway	From-To	Location	Agency	Classification	LOS D Capacity	2005 ADT	Estimated Daily LOS	Project Level*
EAST-WEST STREETS								
Northern Ave.	107th Ave. - 115th Ave.	Glendale	Glendale	4LN Minor Arterial	25,000	9,800	A	Subregional
	115th Ave. - El Mirage	Glendale	Glendale	4LN Minor Arterial	25,000	7,200	A	Subregional
	El Mirage - Dysart	Glendale	Glendale	4LN Minor Arterial	25,000	7,700	A	Subregional

TABLE A
SOUTHWEST VALLEY ROADWAY SEGMENT INVENTORY
YEAR 2020 CONDITIONS WITH 2020 SYSTEM PLAN

Revised August 1996

Roadway	From-To	Location	Agency	Classification	LOS E Capacity	2020 ADT	Estimated Daily LOS	Project Level**
I-10	83rd - 91st Ave.	Tolleson	ADOT	8LN Freeway	169,200	152,000	E	None
	91st - 99th Ave.	Tolleson	ADOT	8LN Freeway	169,200	146,800	E	Regional
	99th - 115th Ave.	Avondale	ADOT	6LN Freeway	126,900	120,600	E	None
	115th Ave. - Dysart	Avondale	ADOT	6LN Freeway	126,900	111,300	E	None
	Dysart - Litchfield	Goodyear	ADOT	6LN Freeway	126,900	107,000	E	Regional
	Litchfield - Estrella Pkwy.	Goodyear	ADOT	6LN Freeway	126,900	92,100	D	Regional
	Estrella - Cotton	Goodyear	ADOT	4LN Freeway	80,800	68,400	E	None
	Cotton - Jackrabbit	Goodyear	ADOT	4LN Freeway	80,800	52,900	C	None
	Jackrabbit - Miller	Buckeye/ County	ADOT	4LN Freeway	80,800	50,700	C	None
	Miller - SR 85	County	ADOT	4LN Freeway	80,800	43,100	C	None
	SR 85 - Palo Verde	County	ADOT	4LN Freeway	80,800	35,400	C	None
	Palo Verde - 339th Ave.	County	ADOT	4LN Freeway	80,800	29,600	B	None

Roadway	From-To	Location	Agency	Classification	LOS D Capacity	2020 ADT	Estimated Daily LOS	Project Level**
EAST-WEST STREETS								
Northern Ave.	107th Ave. - 115th Ave.	Glendale	Glendale	4LN Minor Arterial	35,000	14,800	A	Subregional
	115th Ave. - El Mirage	Glendale	Glendale	4LN Minor Arterial	25,000	23,000	D	Subregional

TABL[illegible]4
SOUTHWEST VALLEY ROAD[illegible]EGMENT INVENTORY
YEAR 2020 CONDITIONS WIT[illegible]20 SYSTEM PLAN

Revised August 1[illegible]

Roadway	From-To	Location	Agency	Classification	LOS D Capacity	2020 ADT	Estimated Daily LOS	Project Level**
Ray Rd.	Rainbow Valley Rd. - Airport Rd.	County	County	2LN Minor Collector	6,400	2,200	A	None
NORTH - SOUTH STREETS								
75th Ave.	McDowell - Van Buren	Phoenix	Phoenix	4LN Minor Arterial	25,000	19,200	C	Local
	Van Buren - MC 85	County	County	4LN Minor Arterial	25,000	14,400	A	Local
	MC 85 - Broadway	Phoenix	Phoenix	4LN Minor Arterial	25,000	21,900	C	Local
83rd Ave.	Thomas - McDowell	Phoenix	Phoenix	6LN Principal Arterial	45,000	34,200	B	None
	McDowell - Van Buren	Phoenix	Phoenix	6LN Principal Arterial	45,000	26,300	A	Local
	Van Buren - MC 85	Tolleson	Tolleson	4LN Minor Arterial	25,000	13,500	A	None
	MC 85 - Lower Buckeye	Phoenix	Phoenix	4LN Minor Arterial	25,000	6,800	A	Local
	Lower Buckeye - Broadway	Phoenix	Phoenix	2LN Minor Collector	6,400	1,400	A	None
91st Ave.	Thomas - McDowell	County	Phoenix	4LN Minor Arterial	25,000	20,300	C	None
	McDowell - Van Buren	Tolleson	County	4LN Minor Arterial	25,000	16,100	A	Subregional
	Van Buren - MC 85	Tolleson	County	4LN Minor Arterial	25,000	16,300	A	None
	MC 85 - Lower Buckeye	Phoenix	Phoenix	4LN Minor Arterial	25,000	13,800	A	Subregional
	Lower Buckeye - Southern	Phoenix	Phoenix	4LN Minor Arterial	25,000	9,800	A	Subregional
99th Ave.	Camelback Rd. - Indian School Rd.	Phoenix	County	4LN Minor Arterial	25,000	15,000	A	None
	Indian School Rd. - Thomas Rd.	Phoenix	County	4LN Minor Arterial	25,000	15,600	A	None
	Thomas Rd. - McDowell Rd.	Phoenix	County	4LN Minor Arterial	25,000	13,900	A	None

TABLE A-4
SOUTHWEST VALLEY ROADWAY SEGMENT INVENTORY
YEAR 2020 CONDITIONS WITH 2020 SYSTEM PLAN

Revised August 1996

Roadway	From-To	Location	Agency	Classification	LOS D Capacity	2020 ADT	Estimated Daily LOS	Project Level**
McDowell Rd.	Pebblecreek - Sarival	Goodyear	County	4LN Minor Arterial	25,000	8,300	A	Subregional
	Sarival - Cotton	Goodyear	County	4LN Minor Arterial	25,000	5,500	A	Subregional
	Cotton - Citrus	Goodyear	County	4LN Minor Arterial	25,000	17,800	B	Subregional
	Citrus - Perryville	Goodyear	County	4LN Minor Arterial	25,000	17,000	B	Subregional
	Perryville - Jackrabbit	County	County	2LN Minor Collector	6,400	2,300	A	None
	Jackrabbit - Airport	County	County	2LN Minor Collector	6,400	-	-	None
	Airport - Watson	Buckeye	Buckeye	2LN Minor Collector	6,400	-	-	Subregional
Van Buren St.	**67th Ave. - 75th Ave.**	**Phoenix**	**Phoenix**	**4LN Minor Arterial**	**25,000**	**25,900**	**E**	**Subregional**
	75th Ave. - 83rd Ave.	Phoenix	Phoenix	4LN Minor Arterial	25,000	22,900	D	Subregional
	83rd - 96th Ave.	Tolleson	Tolleson	4LN Minor Arterial	25,000	14,900	A	None
	96th - 99th Ave.	Tolleson	County	4LN Minor Arterial	25,000	17,200	B	None
	99th - 101st Ave.	Tolleson	County	6LN Principal Arterial	45,000	17,600	A	Subregional
	101st - 107th Ave.	Tolleson	County	6LN Principal Arterial	45,000	17,600	A	Subregional
	107th - 115th Ave.	County	County	6LN Principal Arterial	45,000	14,300	A	Subregional
	115th Ave. - El Mirage	Avondale	County	6LN Principal Arterial	45,000	16,800	A	Subregional
	El Mirage - Dysart	Avondale	County	4LN Minor Arterial	25,000	16,800	B	None
	Dysart - Litchfield	Goodyear	Goodyear	4LN Minor Arterial	25,000	-	-	None
	Litchfield - Bullard	Goodyear	Goodyear	4LN Minor Arterial	25,000	13,000	A	Subregional
	Bullard - Estrella Pkwy.	Goodyear	Goodyear	4LN Minor Arterial	25,000	12,000	A	Subregional
	Estrella Pkwy. - Sarival	Goodyear	County	4LN Minor Arterial	25,000	5,000	A	Subregional

TABL[illegible]
SOUTHWEST VALLEY ROADW[illegible] [illegible]EGMENT INVENTORY
YEAR 2020 CONDITIONS WITH 2020 SYSTEM PLAN

Revised August 1996

Roadway	From-To	Location	Agency	Classification	LOS D Capacity	2020 ADT	Estimated Daily LOS	Project Level**
Van Buren St.	Sarival - Cotton	Goodyear	County	2LN Minor Collector	6,400	5,500	C	None
	Cotton - Citrus	Goodyear	County	2LN Minor Collector	6,400	6,700	E	None
	Citrus - Perryville	County	County	2LN Minor Collector	6,400	6,100	D	None
	Perryville - Jackrabbit	Buckeye	County	2LN Minor Collector	6,400	1,100	A	None
	Jackrabbit - Tuthill	Buckeye	Buckeye	2LN Minor Collector	6,400	5,200	C	None
	Tuthill - Dean	Buckeye	Buckeye	2LN Minor Collector	6,400	2,900	A	Subregional
MC 85	67th Ave. - 75th Ave.	Phoenix	Phoenix	6LN Principal Arterial	45,000	29,200	A	Regional
	75th Ave. - 83rd Ave.	Phoenix	Phoenix	6LN Principal Arterial	45,000	34,700	B	Regional
	83rd Ave. - 91st Ave.	Phoenix	Phoenix	6LN Principal Arterial	45,000	29,000	A	Regional
	91st Ave. - 99th Ave.	Tolleson	County	6LN Principal Arterial	45,000	30,900	B	Regional
	99th Ave. - 107th Ave.	Tolleson	County	4LN Minor Arterial	25,000	24,600	D	None
	107th Ave. - 115th Ave.	Avondale	County/ Avondale	4LN Minor Arterial	25,000	15,900	A	None
	115th Ave. - El Mirage Rd.	Avondale	County/ Avondale	4LN Minor Arterial	25,000	19,700	C	None
	El Mirage - Dysart	Avondale	County/ Avondale	4LN Minor Arterial	25,000	19,000	B	None
	Dysart - Litchfield	Avondale	Avondale	4LN Minor Arterial	25,000	-	-	None
	Litchfield - Bullard	Goodyear	County/ Goodyear	6LN Principal Arterial	45,000	30,000	A	Regional
	Bullard - Estrella Pkwy.	Goodyear	County	6LN Principal Arterial	45,000	30,000	A	Regional
	Estrella Pkwy. - Sarival	Goodyear	County	6LN Principal Arterial	45,000	26,900	A	Regional

TABLE A-4
SOUTHWEST VALLEY ROADWAY SEGMENT INVENTORY
YEAR 2020 CONDITIONS WITH 2020 SYSTEM PLAN

Revised August 1996

Roadway	From-To	Location	Agency	Classification	LOS D Capacity	2020 ADT	Estimated Daily LOS	Project Level**
99th Ave.	McDowell - Roosevelt	Tolleson	Tolleson	4LN Minor Arterial	25,000	12,700	A	None
	Roosevelt - Van Buren	Tolleson	Tolleson	4LN Minor Arterial	25,000	12,700	A	None
	Van Buren - MC 85	Tolleson	Tolleson	4LN Minor Arterial	25,000	16,900	B	None
	MC 85 - Broadway	Phoenix	Phoenix	4LN Minor Arterial	25,000	9,200	A	Regional
	Broadway - Southern	Phoenix	Phoenix	2LN Minor Collector	6,400	3,100	A	None
107th Ave.	Bethany Home - Camelback	Phoenix	Phoenix	4LN Minor Arterial	25,000	13,500	A	Subregional
	Camelback Rd. - Indian School Rd.	Phoenix	Phoenix	4LN Minor Arterial	25,000	19,100	C	Subregional
	Indian School - Thomas	Avondale	Avondale	4LN Minor Arterial	25,000	17,800	B	Subregional
	Thomas - Palm Ln.	Avondale	County	4LN Minor Arterial	25,000	18,100	B	Subregional
	Palm Ln. - McDowell	Avondale	County	6LN Principal Arterial	45,000	18,100	A	Subregional
	McDowell - Van Buren	Avondale	County	4LN Minor Arterial	25,000	17,300	B	Subregional
	Van Buren - MC 85	Avondale	County	4LN Minor Arterial	25,000	17,200	B	Subregional
	MC 85 - Lower Buckeye	Phoenix	Phoenix	4LN Minor Arterial	25,000	10,300	A	Subregional
	Lower Buckeye - Broadway	Phoenix	Phoenix	2LN Minor Collector	6,400	5,600	C	None
	Broadway - Southern	Phoenix	Phoenix	2LN Minor Collector	6,400	-	-	None
115th Ave.	Thomas - McDowell	Avondale	County	4LN Minor Arterial	25,000	17,000	B	Subregional
	McDowell - Van Buren	County	County	4LN Minor Arterial	25,000	16,900	B	Subregional
	Van Buren - MC 85	Avondale	County	4LN Minor Arterial	25,000	15,900	A	Subregional
	MC 85 - Lower Buckeye	Avondale	County	4LN Minor Arterial	25,000	8,200	A	None

TABLE 9.3 (Continued)
SHORT-RANGE (FIVE-YEAR) CAPITAL IMPROVEMENTS PROGRAM SUMMARY, 1996-2001

City of Goodyear

Project Location	Project Description	Project Level	Estimated Cost ($000)
Van Buren St. at Bullard Wash	Construct bridge	Local	$ 500
Various south Goodyear roads	Pave	Local	1,750
Bullard Ave., Indian School Bypass - Yuma Rd.	Reconstruct and pave	Local	1,115
Various	Street construction/ widening	Local	690
Total			**$ 26,016**

City of Litchfield Park

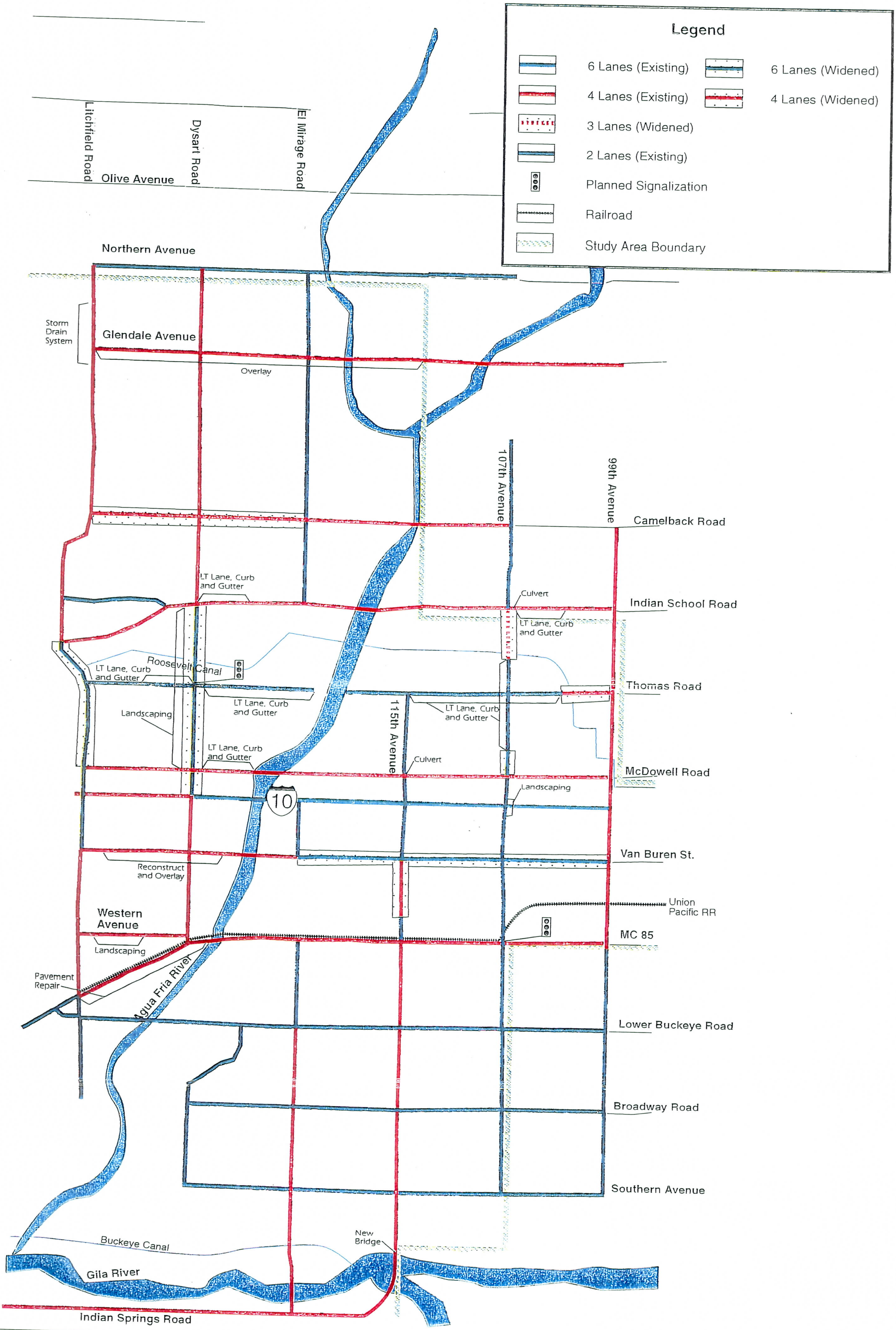
Project Location	Project Description	Project Level	Estimated Cost ($000)
Various interior streets	Pavement preservation	Local	$ 905

City of Tolleson

Project Location	Project Description	Project Level	Estimated Cost ($000)
Various neighborhood streets	Construct new roadway	Local	$ 1,680

Maricopa County

Project Location	Project Description	Project Level	Estimated Cost ($000)
Camelback Rd., El Mirage Rd. - Litchfield Rd.	Widen from 2 to 4 lanes	Regional	$ 3,236
Watson Rd., Southern Ave. - MC 85	Construct 2-lane roadway	Subregional	615
Thomas Rd., 91st - 99th Ave.	Widen from 2 to 4 lanes (County Share)	Subregional	125
91st Ave., McDowell Rd. - Van Buren St.	Widen from 2 to 4 lanes	Subregional	2,500
116th Ave. at Gila River	Construct bridge (County share)	Subregional	4,410



Southwest Valley Transportation Study

Avondale Study Area: Five-Year Projects and Year 2001 Proposed Number of Lanes

Source: BRW, Inc., 23 May 1996.

Figure 6-2

BRW

Partners for Strategic Action

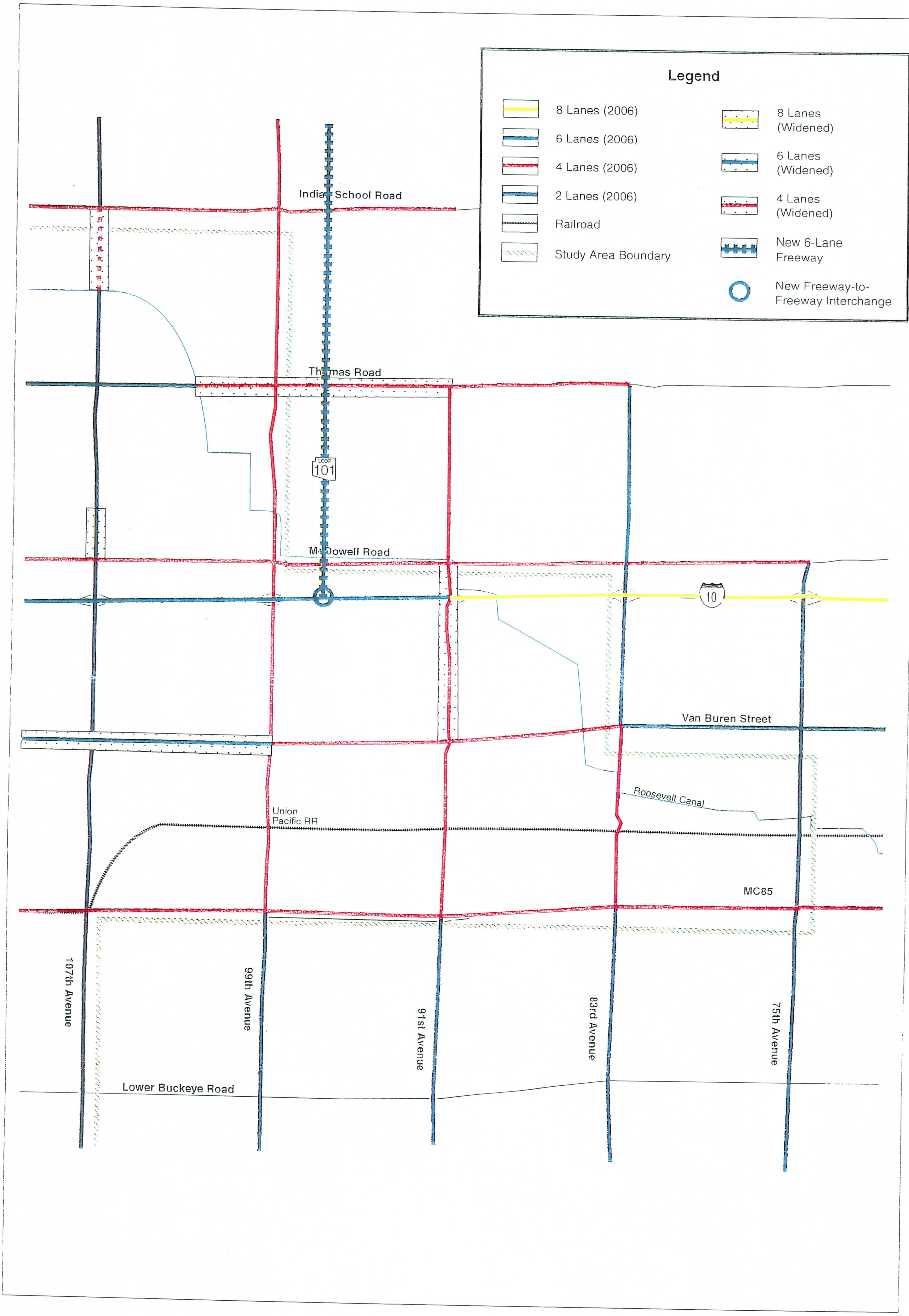


Figure 3-1 Future Transportation Projects

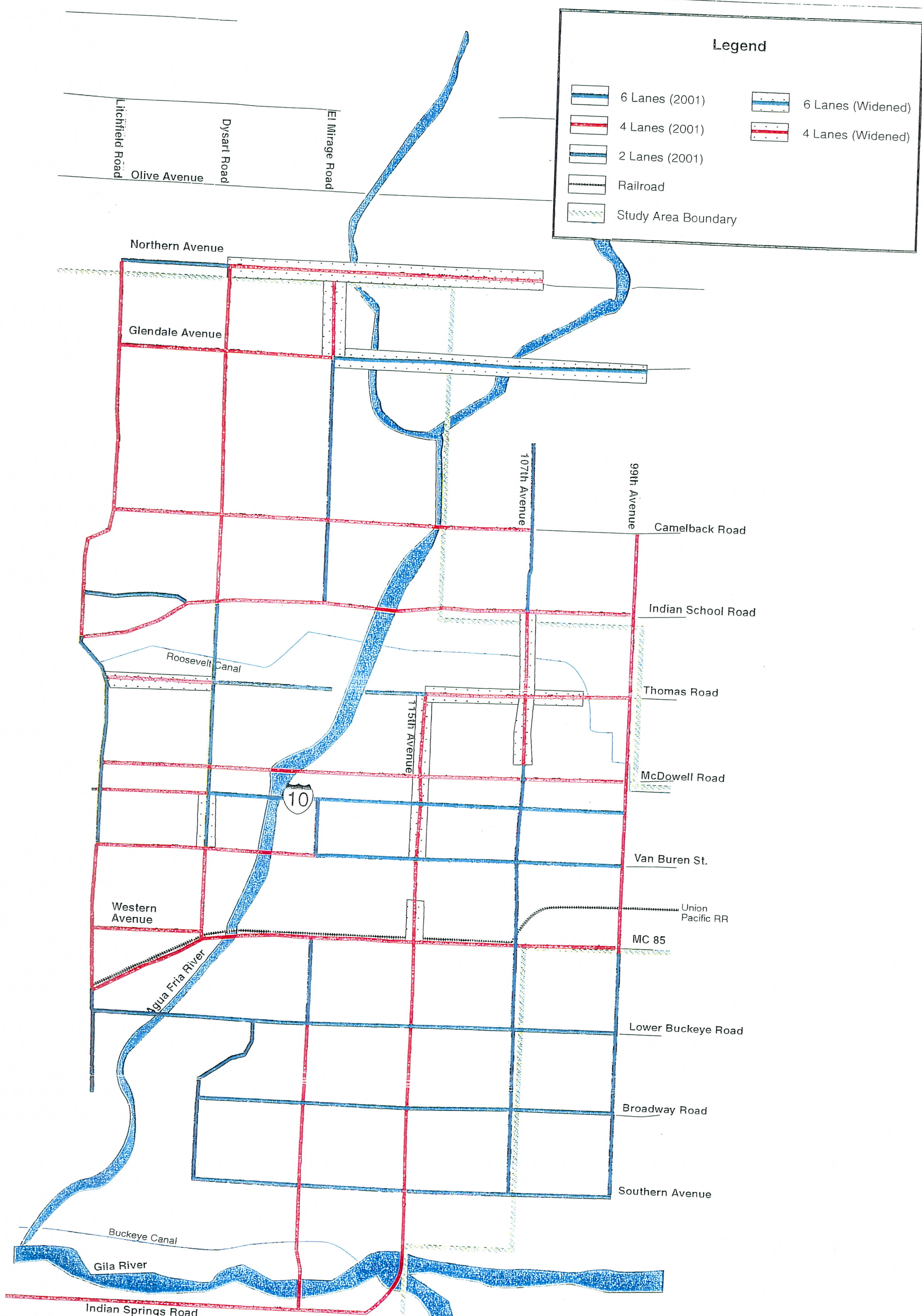
Source: BRW, Inc., 23 May 1996.

Southwest Valley Transportation Study

Tolleson Study Area: Five-Year Projects and Year 2001 Proposed Number of Lanes

BRW

Partners for Strategic Action



Southwest Valley Transportation Study

Avondale Study Area: Ten-Year Projects and Year 2006 Proposed Number of Lanes

Source: BRW, Inc., 23 May 1996.

Figure 6-6

BRW

Partners for Strategic Action

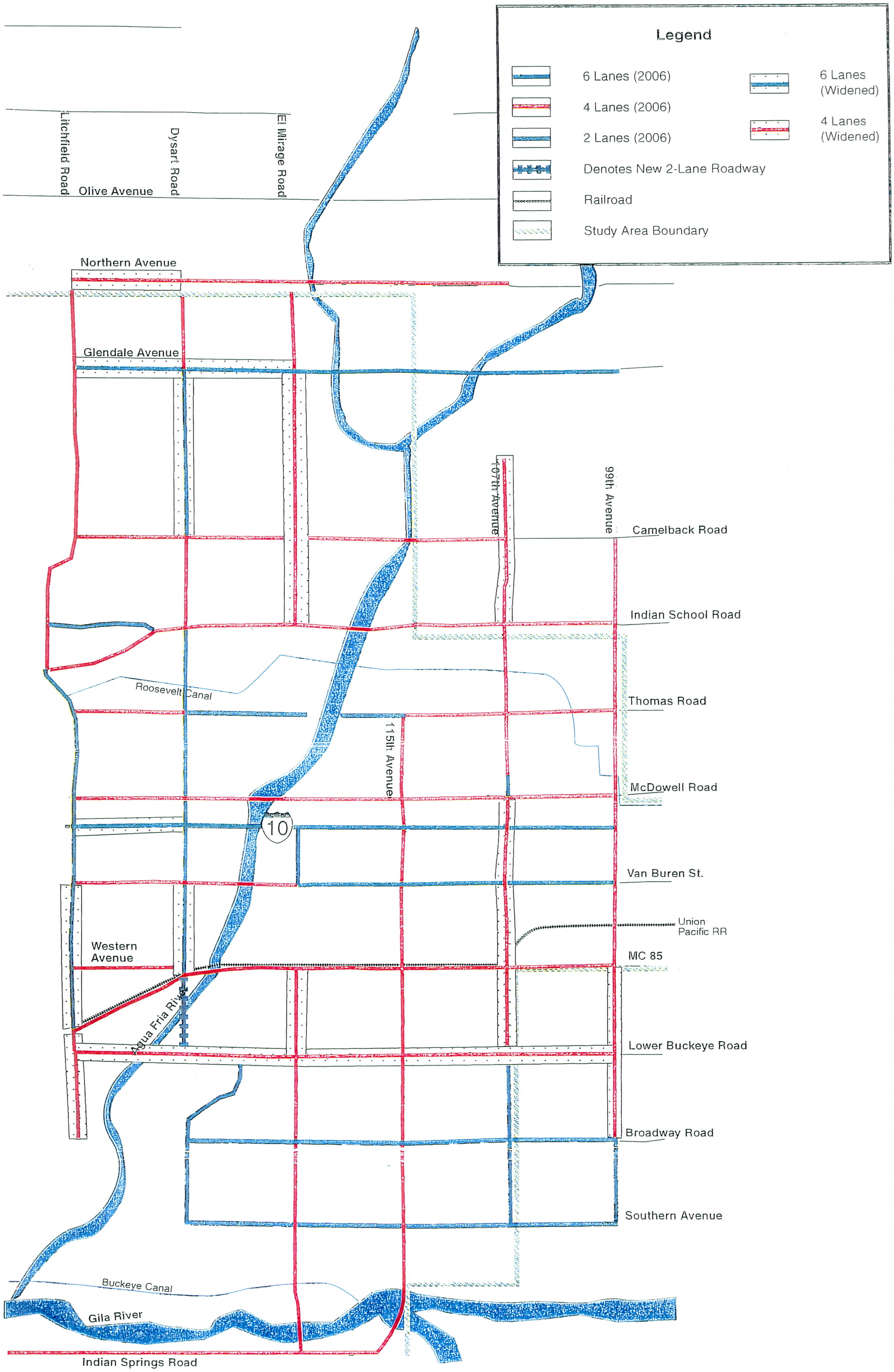
Southwest Valley Transportation Study

Tolleson Study Area: Ten-Year Projects and Year 2006 Proposed Number of Lanes

Source: BRW, Inc., 23 May 1996.

Figure 6-9

Partners for Strategic Action



Southwest Valley Transportation Study

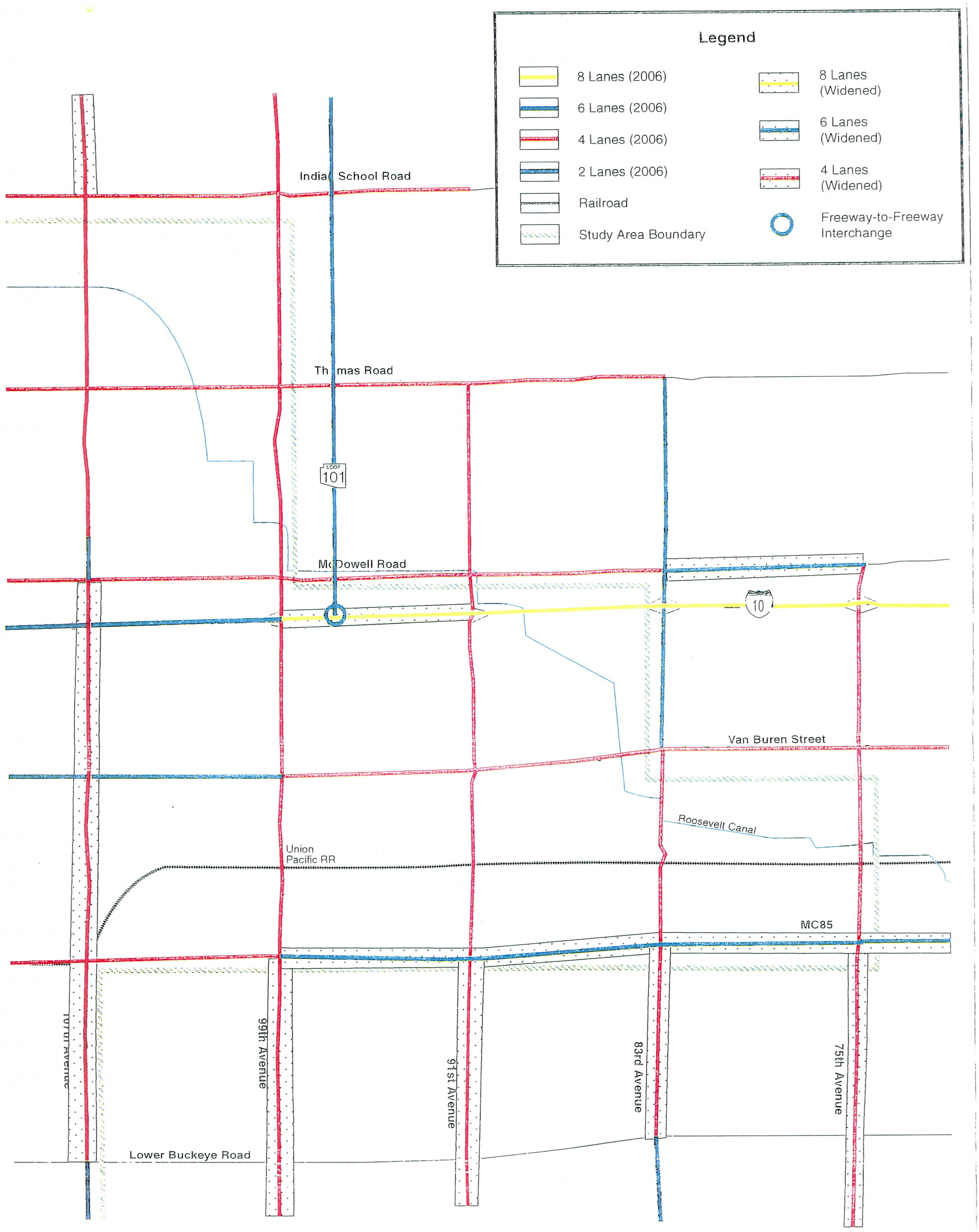
Avondale Study Area: 25-Year Projects and Year 2020 Proposed Number of Lanes

Source: BRW, Inc., 23 May 1996.

Figure 6-10

BRW

Partners for Strategic Action



Southwest Valley Transportation Study

Tolleson Study Area: 25-Year Projects and Year 2020 Proposed Number of Lanes

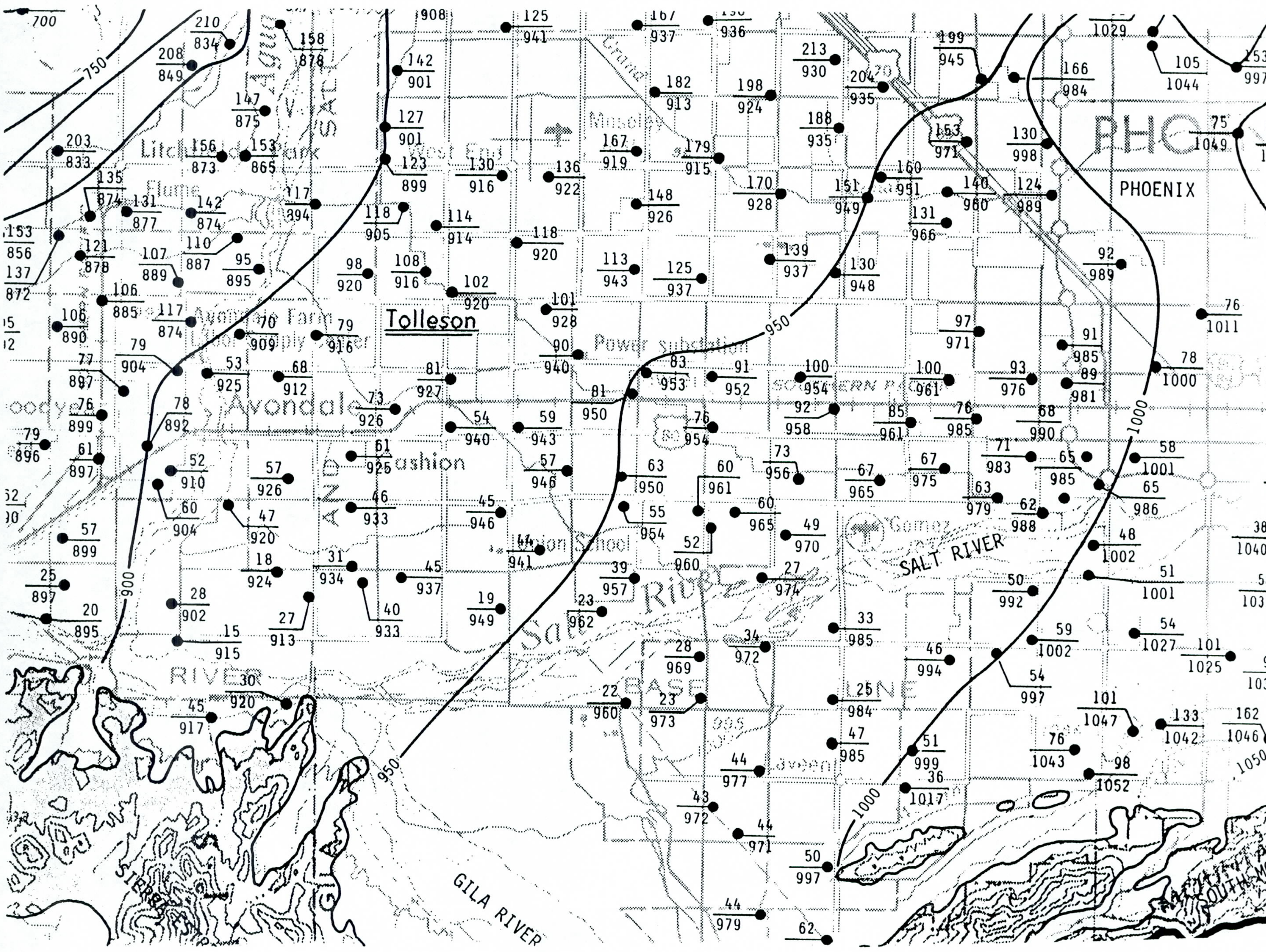
Source: BRW, Inc., 23 May 1996.

Figure 6-13

BRW

TPA Partners for Strategic Action

APPENDIX E-8: Excerpts from Department of Water Resources Hydrologic Map Series Report Number 12



EXPLANATION

68/1022 WELL FIELD CHECKED IN 1982--First number, 68, is depth to water in feet below land surface. Second number, 1022, is the altitude of the water level in feet above mean sea level

168/1109 WELL FIELD CHECKED IN 1982--Well with anomalously shallow 1982 water level. First number, 168, is depth to water in feet below land surface. Second number, 1109, is the altitude of the water level in feet above mean sea level

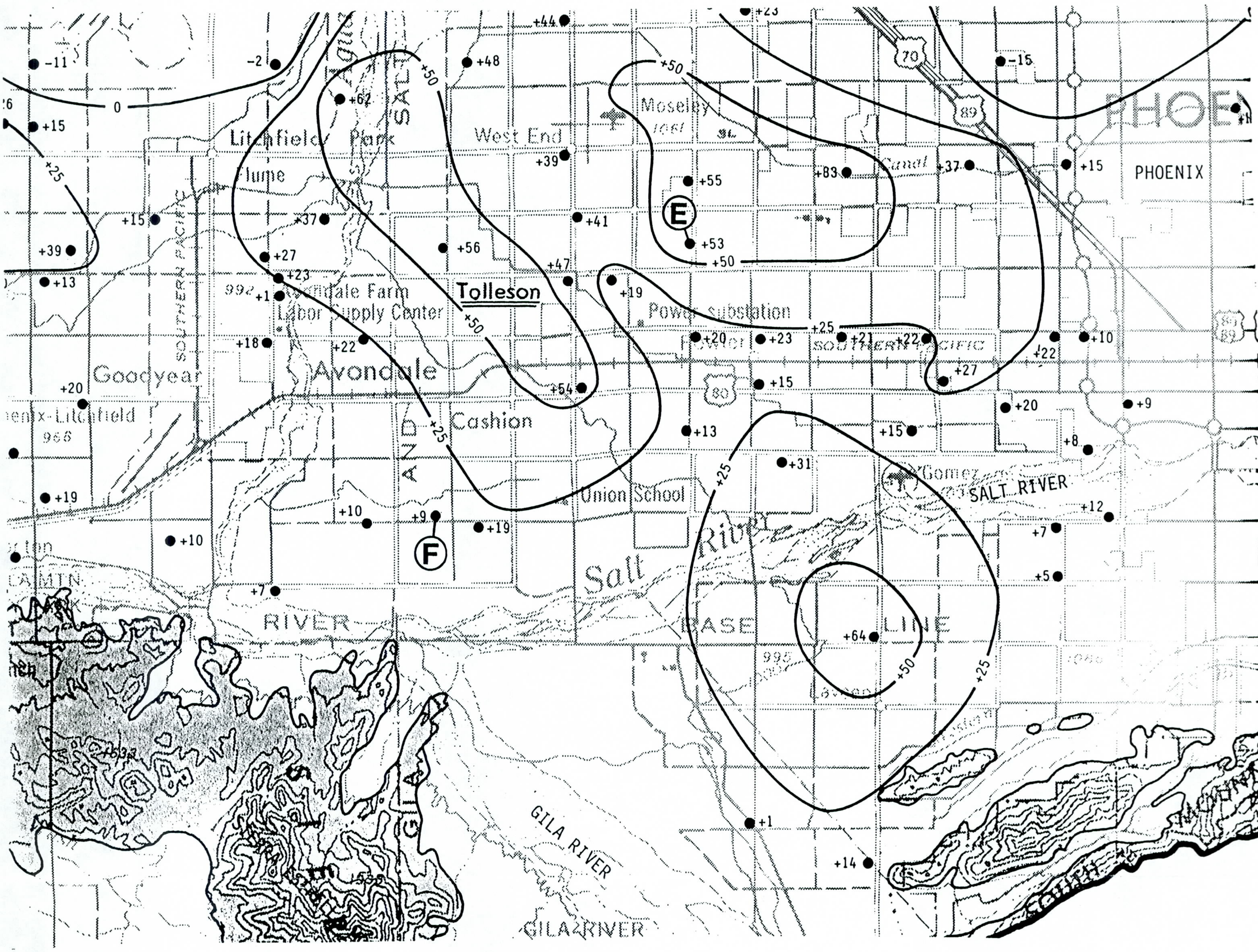
3550 SPRING FIELD CHECKED IN 1982--Number, 3550, is altitude of the land surface in feet above mean sea level

VALLEY-FILL DEPOSITS--Main water-bearing unit consisting of silt, sand, clay, and gravel

BEDROCK (VOLCANIC, GRANITIC, METAMORPHIC, OR SEDIMENTARY ROCK)--Water may occur in faulted or fractured zones, joint systems, or thin veneer of alluvial or fluvial sediment overlying bedrock

1050 WATER LEVEL CONTOUR--Shows altitude of the water level. Contour interval 50 feet. *Datum is* mean sea level

ARBITRARY BOUNDARY OF PHOENIX ACTIVE MANAGEMENT AREA (EXCLUDING HASSAYAMPA AND RAINBOW VALLEY SUB-BASINS)



EXPLANATION

+12 WELL IN WHICH WATER LEVEL WAS MEASURED IN 1976 AND 1983--Number, +12, is the difference, in feet, between the 1976 and 1982 measurements

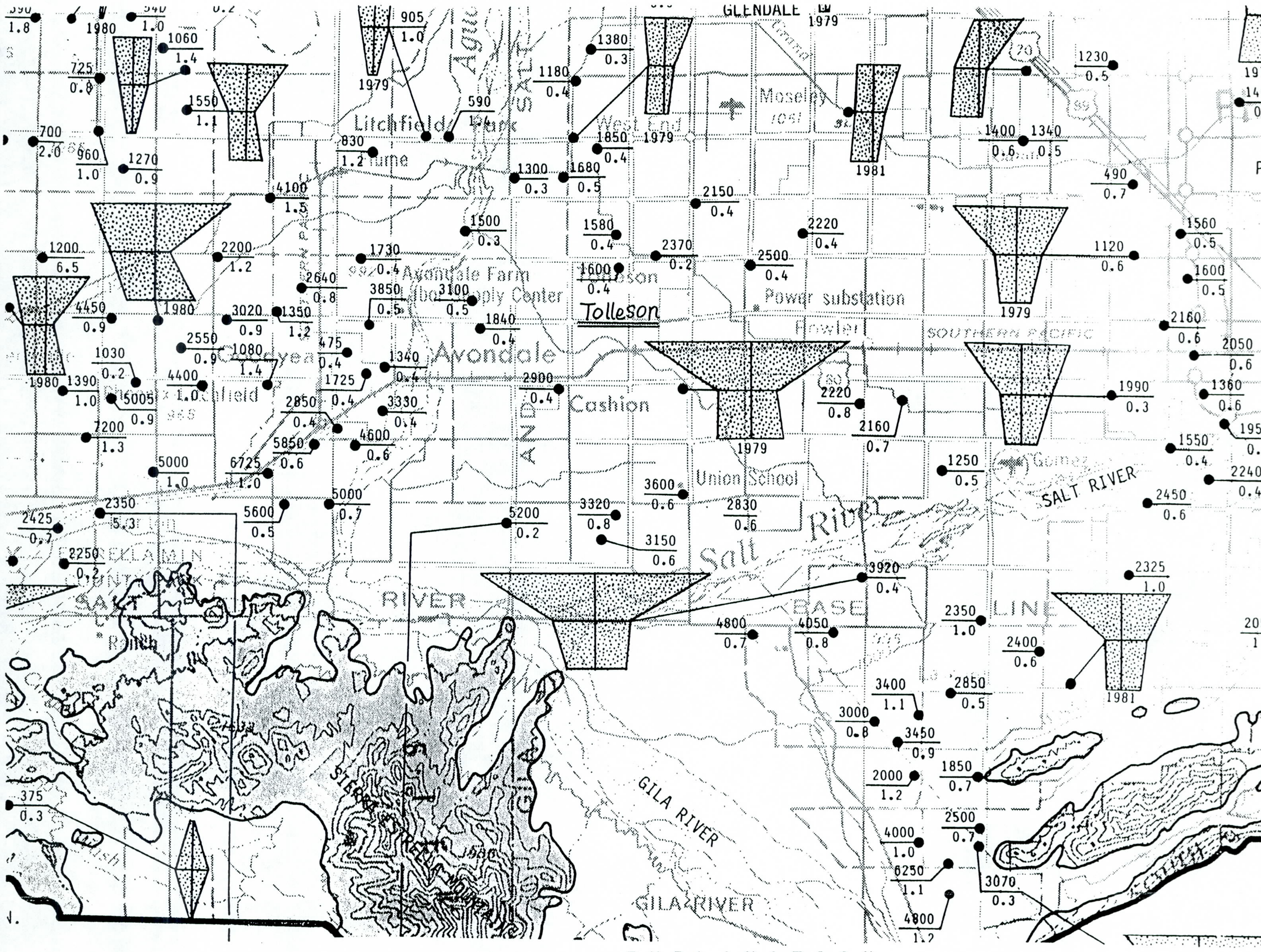
A WELL FOR WHICH A HYDROGRAPH DEPICTING CHANGES IN DEPTH TO WATER IS SHOWN

VALLEY-FILL DEPOSITS--Main water-bearing unit consisting of silt, sand, clay, and gravel

BEDROCK (VOLCANIC, GRANITIC, METAMORPHIC, OR SEDIMENTARY ROCK)--Water may occur in faulted or fractured zones, joint systems, or thin veneers of alluvial or fluvial sediment overlying bedrock

+25 APPROXIMATE LINE OF EQUAL CHANGE IN WATER LEVEL, 1976-1983--Contour interval 25, 50,and 100 feet

ARBITRARY BOUNDARY OF PHOENIX ACTIVE MANAGEMENT AREA (EXCLUDING HASSAYAMPA AND RAINBOW VALLEY SUB-BASINS)



EXPLANATION

1600 / 0.6 — WELL FOR WHICH A WATER SAMPLE WAS COLLECTED IN 1982-83--First number, 1600, is specific conductance in micromhos per centimeter at 25°C (specific conductance is an indication of the dissolved-solids concentration in water). Second number, 0.6, is the fluoride concentration in milligrams per liter

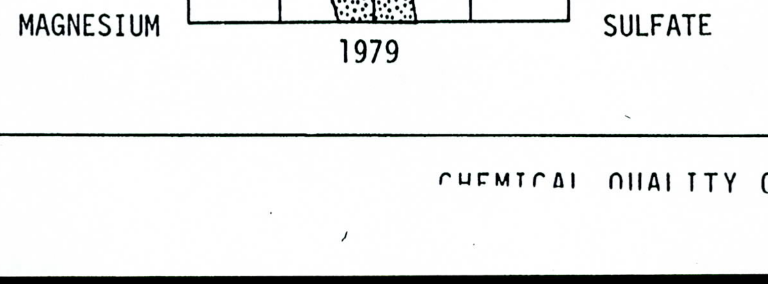
280 / 0.4 — SPRING FOR WHICH A WATER SAMPLE WAS COLLECTED IN 1982-83--First number, 280, is specific conductance in micromhos per centimeter at 25°C (specific conductance is an indication of the dissolved-solids concentration in water). Second number, 0.4, is the fluoride concentration in milligrams per liter

VALLEY-FILL DEPOSITS--Main water-bearing unit consisting of silt, sand, clay, and gravel

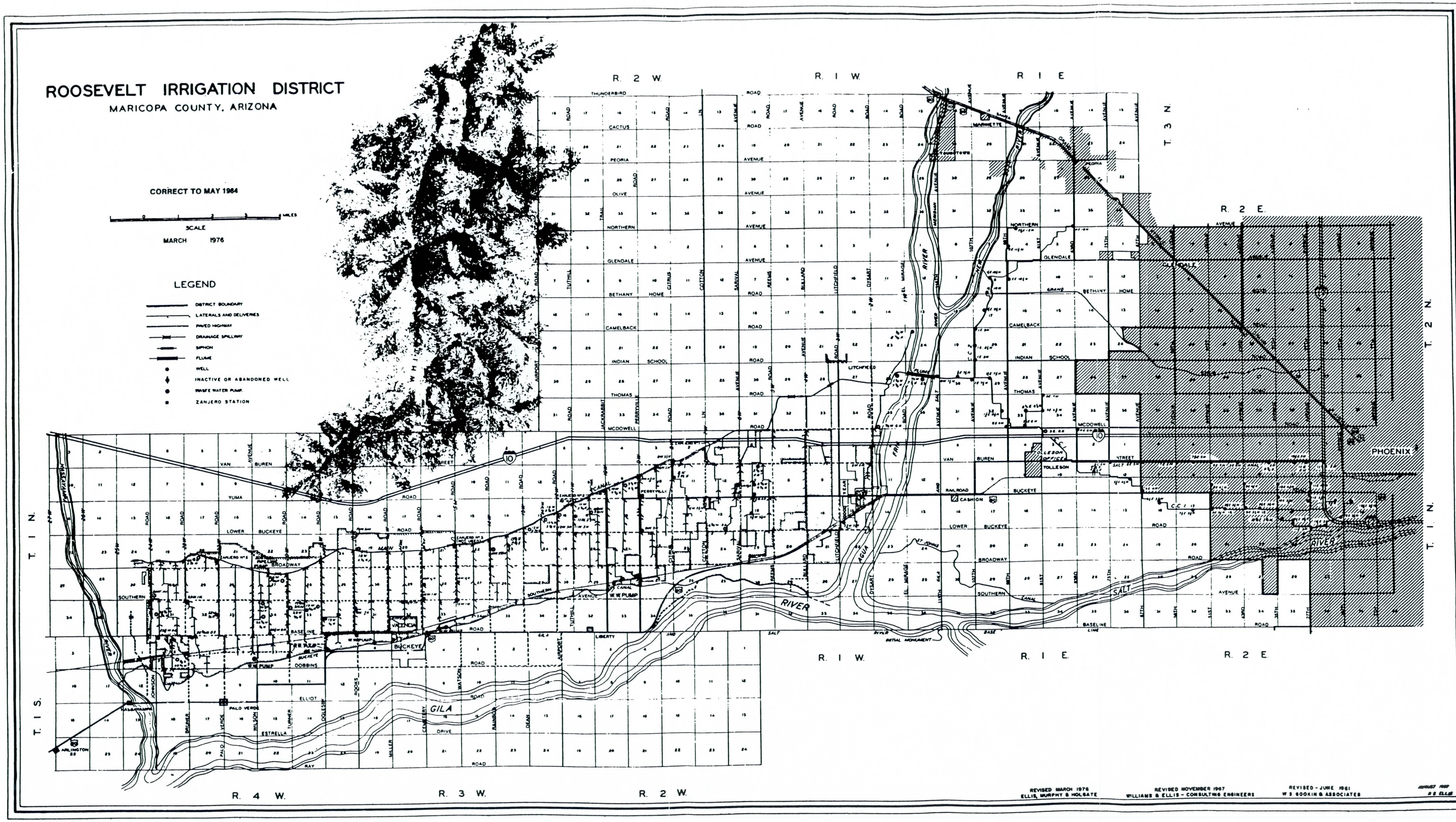
BEDROCK (VOLCANIC, GRANITIC, METAMORPHIC, OR SEDIMENTARY ROCK)--Water may occur in faulted or fractured zones, joint systems, or thin veneer of alluvial or fluvial sediment overlying bedrock

ARBITRARY BOUNDARY OF PHOENIX ACTIVE MANAGEMENT AREA (EXCLUDING HASSAYAMPA AND RAINBOW VALLEY

CHEMICAL QUALITY DIAGRAM--Shows major constituents in milliequivalents per liter. The diagrams are in a variety of shapes and sizes, providing a means of comparing, correlating, and characterizing similar or dissimilar types of water. Year, 1979, below diagram indicates sample collected in years other than 1982-83



MAPS



ROOSEVELT IRRIGATION DISTRICT
MARICOPA COUNTY, ARIZONA
CORRECT TO MAY 1984
0 1 2 3 4 MILES
SCALE
MARCH 1976
LEGEND
DISTRICT BOUNDARY
LATERALS AND DELIVERIES
PAVED HIGHWAY
DRAINAGE SPILLWAY
SIPHON
FLUME
WELL
INACTIVE OR ABANDONED WELL
WASTE WATER PUMP.
ZANJERO STATION
R. 2 W.
R. I W.
R. I E.
R. 2 E.
T. 3 N.
T. 2 N.
T. I N.
T. I S.
R. 4 W.
R. 3 W.
R. 2 W.
R. I W.
R. I E.
R. 2 E.
PHOENIX
GLENDALE
TOLLESON
BUCKEYE
LITCHFIELD
CASHION
ARLINGTON
GILA
SALT
RIVER
AGUA FRIA RIVER
NEW RIVER
HASSAYAMPA RIVER
THUNDERBIRD
CACTUS
PEORIA
OLIVE
NORTHERN
GLENDALE
BETHANY HOME
CAMELBACK
INDIAN SCHOOL
THOMAS
MCDOWELL
VAN BUREN
YUMA
LOWER BUCKEYE
BROADWAY
SOUTHERN
BASELINE
DOBBINS
ELLIOT
PALO VERDE
ESTRELLA
RAY
W.W. PUMP
REVISED MARCH 1976
ELLIS, MURPHY & HOLGATE
REVISED NOVEMBER 1967
WILLIAMS & ELLIS - CONSULTING ENGINEERS
REVISED - JUNE 1961
W S GOOKIN & ASSOCIATES

\pr)\WFCD19\Cad\Utility\UTILITY-91A6-18.dwg Thu Jul 29 08:55:34 1999 PRIMATECH

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TOLLESON

SPRR & VAN BUREN STREET AT
91ST AVENUE DRAINAGE IMPROVEMENT

FOR FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY

EXISTING UTILITIES
VAN BUREN STREET

PRIMATECH
ENGINEERS & CONSULTANTS

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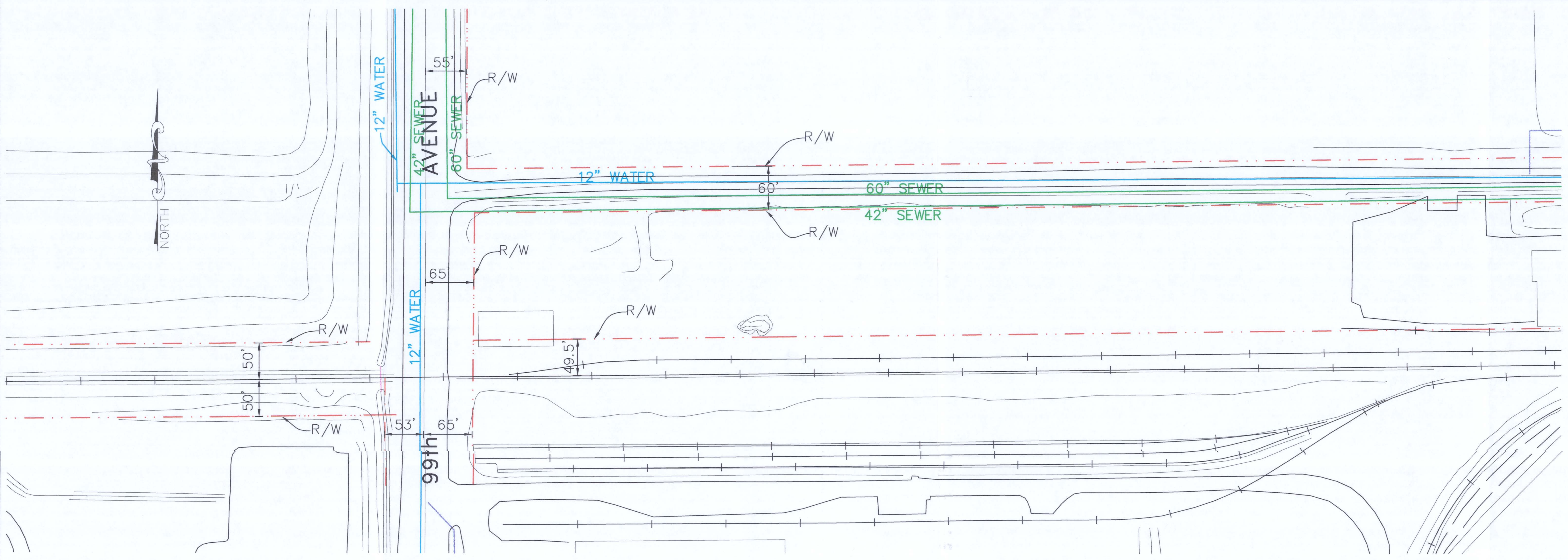

LEGEND

BUILDING	RIGHT-OF-WAY
SINGLE RESIDENTIAL BUILDING	IRRIGATION PIPE (IRRI)
ROAD/PAVEMENT	WATER LINE (WATER)
DIRT ROAD	SEWER LINE (SEWER)
HIDDEN ROAD/HIDDEN PAVEMENT	ELECTRICITY LINE (ELECTRICITY)
CURB	GAS LINE (GAS)
HIDDEN CURB	TELEPHONE LINE (TELEPHONE)
RAILROAD	
HORIZONTAL & VERTICAL CONTROL POINT	
VERTICAL CONTROL POINT	

TOLLESON

SPRR & VAN BUREN STREET AT
91ST AVENUE DRAINAGE IMPROVEMENT

FOR FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY

EXISTING UTILITIES
SOUTHERN PACIFIC RAILROAD
SHEET 1

PRIMATECH
ENGINEERS & CONSULTANTS

\prj\MFC019\Cad\Drainage\UTILITY-SPRR6-18.dwg Thu Jul 08 00:50:23 1999 PRIMATECH

TOLLESON

SPRR & VAN BUREN STREET AT
91ST AVENUE DRAINAGE IMPROVEMENT

FOR FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY

EXISTING UTILITIES
SOUTHERN PACIFIC RAILROAD
SHEET 2

PRIMATECH
ENGINEERS & CONSULTANTS

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\prj\MFC019\Cad\Utility\UTILITY-SPRR-18.dwg Thu Jul 29 09:33:04 1999 PRIMATECH

TOLLESON

SPRR & VAN BUREN STREET AT
91ST AVENUE DRAINAGE IMPROVEMENT

FOR FLOOD CONTROL DISTRICT OF
MARICOPA COUNTY

EXISTING UTILITIES
SOUTHERN PACIFIC RAILROAD
SHEET 4

PRIMATECH
ENGINEERS & CONSULTANTS

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