Hohokam Area Drainage Master Study
Phase I Study Report
Contract FCD 2009C029
July 2012

Prepared for:

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

and

City of Phoenix
200 W. Washington St.
Phoenix, AZ 85003

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LOGAN SIMPSON DESIGN INC.

Riada Engineering, Inc.

RG Civil Engineering Services

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1. EXECUTIVE SUMMARY

1.1 PROJECT DESCRIPTION, PURPOSE & GOALS

The Hohokam Area Drainage Master Study/Plan (ADMS/ADMP) is a two-phase regional flood control planning project to determine the nature and magnitude of existing flood hazards; develop and evaluate potential flood mitigation alternatives; provide preliminary design plans for recommended improvements; and ultimately provide a comprehensive plan to address flooding within the study area and guide future development and flood control improvements.

This report documents Phase I, the Hohokam Area Drainage Master Study (ADMS). The Hohokam ADMS is a comprehensive data collection and investigation effort to identify and quantify existing and potential future flood hazards and document archeological, cultural, landscape, and recreational resources and opportunities that will serve as the basis to formulate and assess mitigation alternatives. The effort includes development of hydrologic/hydraulic models to simulate flooding conditions; data collection and site investigations; and public outreach to gather essential information on existing flooding conditions and to incorporate the issues, concerns and values of the public into the decision making process. In addition, stakeholder involvement and participation is included to keep them informed on the project, facilitate the data collection effort and to identify potential opportunities for flood control improvements.

Phase II, the Hohokam Area Drainage Master Plan (ADMP), will utilize the results of the ADMS to formulate flood mitigation alternatives and through three levels of alternative formulation, analysis and evaluation, ultimately make recommendations for study area improvements. The ADMP will expand upon the public outreach and involvement efforts and develop concept plans for recommended improvements. Recommended improvements will be prioritized and a strategy for implementation prepared.

1.2 AUTHORIZATION

The Flood Control District of Maricopa County (FCDMC) authorized the performance of the Hohokam ADMS/ADMP under contract FCD 2009C029 with an effective Notice-to-Proceed date of May 12, 2010.

1.3 LOCATION

The Hohokam ADMS/ADMP study area is located within the limits of the City of Phoenix and the City of Tempe. The area is approximately 28.1 sq. miles in size and bounded by I-10 to the north and east, the Salt River to the north, South Mountain Park to the south and the limits of the Laveen ADMS to the west (see Figure 1-1).

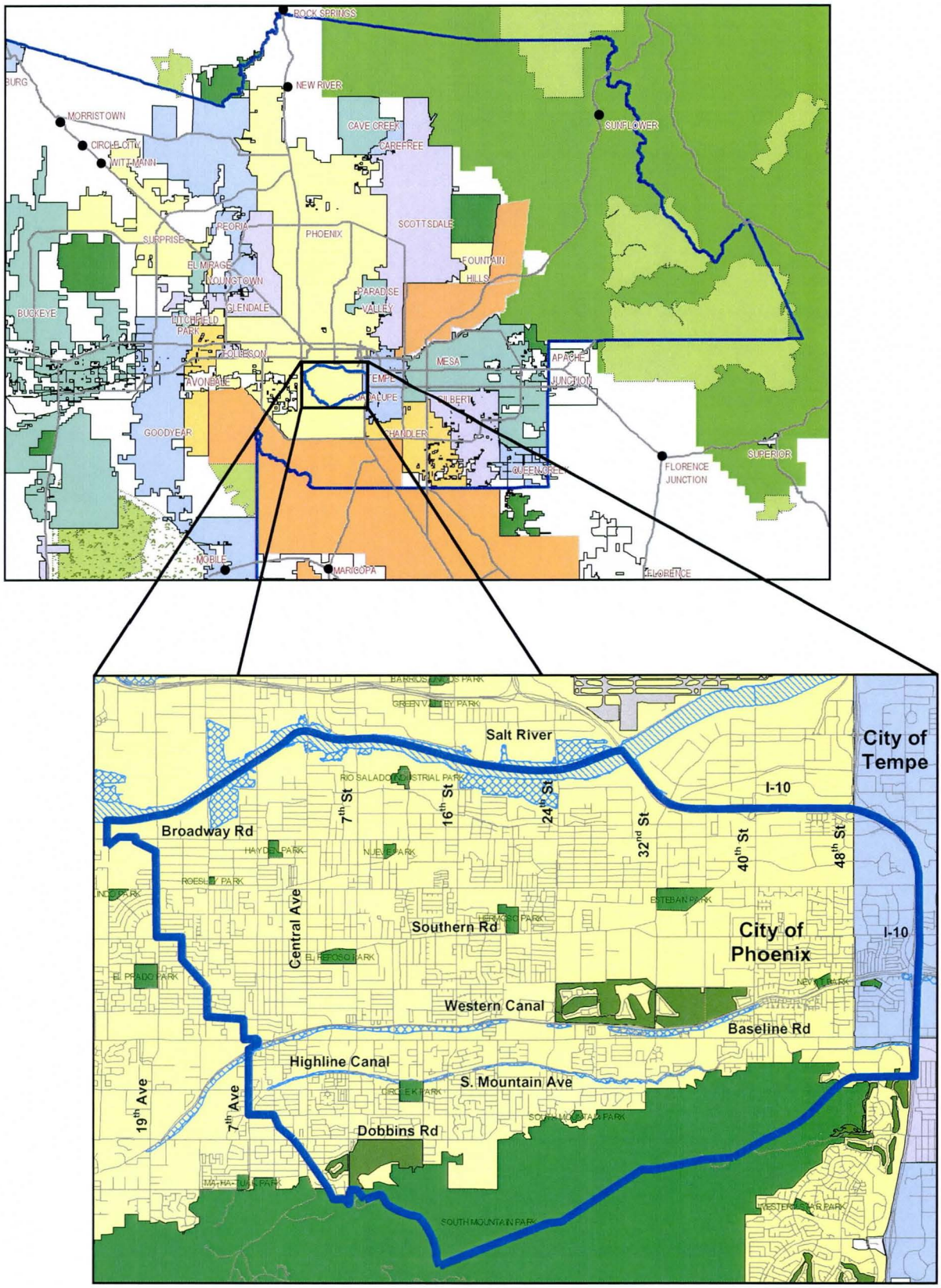


Figure 1-1: Project Location and Vicinity Map

1.4 OVERVIEW OF STUDY AREA

The Hohokam study area is approximately 28 square miles in size and located north of South Mountain in south Phoenix and western Tempe. Historically, the area was largely agricultural land irrigated by a system of canals, however, while a few fields still remain, much of the agricultural land has been retired and replaced with residential housing, commercial development and industrial areas. The study area watershed generally drains to the north and west; from the South Mountains to the Salt River. Possibly due to the area's extended agricultural history, no continuous natural washes remain to drain the watershed to the Salt River, nor are there any continuous manmade conveyances except as provided by the City of Phoenix's (COP) storm drain system. Storm water not captured by the storm drain system, retained in basins, or impounded behind canals, is carried overland and along surface streets.

Among the most significant features in the area are the Salt River and South Mountain. South Mountain defines the southern boundary of the study area and is home to the South Mountain Park/Preserve. The park is 16,000 acres in size and one of the largest municipal parks in the country attracting an estimated 3 million visitors a year. This desert mountain park/preserve includes riding and hiking trails, picnic areas and scenic overlooks. The Salt River defines much of the northern boundary of the study area. Historically, the river and its floodplain were the lifeblood of the area providing water and fertile land for agriculture. Just after the turn of the century, the U.S. Bureau of Reclamation placed dams along the river to provide a reliable supply of water year round. The once flowing river became a dry riverbed that was soon occupied with sand and gravel mining activities. Today, much of the south overbank of the river within the study area is still being mined; however, recent efforts have been made to restore the riparian habitat that once existed along the river. The Rio Salado Habitat Restoration Area extends 5 miles along the Salt River from 28th St. to 19th Ave. Trash, from illegal dumping, and debris have been removed from this reach of the river and the banks have been terraced to provide areas for multi-use paths and environmental educational facilities. An extensive revegetation effort using native riparian plant material has been undertaken to restore critical habitat to the area.

Also among the most significant features in the watershed are the Salt River Project's (SRP) Western and Highline Irrigation Canals. The canals are roughly parallel to each other, draining from east to west, subdividing the study area and disrupting natural drainage patterns. As a result, approximate flood hazard zones have been delineated along the canals where ponding occurs.

1.5 HOHOKAM ADMS REPORTS

Several reports have been prepared as part of the Hohokam ADMS. These previous reports include:

- Hohokam ADMS Data Collection Report

- Hohokam ADMS/ADMP Class I Cultural Resources Inventory Survey
- Hohokam ADMS Pilot Study & Sensitivity Analysis Drainage Memorandum
- Hohokam ADMS Hydrology & Hydraulics Report

1.6 PARTICIPATION

Major project participants include the FCDMC, the City of Phoenix, the consultant team comprised of members from Stanley Consultants Inc. (SCI), JE Fuller Hydrology and Geomorphology (JEF), Logan Simpson Design (LSD), Riada Engineering (RE) and RG Engineering Services (RG). Additional stakeholders include the City of Tempe, Arizona Department of Transportation (ADOT), Salt River Project (SRP), and Valley Metro.

1.7 PROJECT NEED

South of the Highline Canal, the study area is relatively steep and experiences intense concentrated flooding as the result of runoff from the mountains. Residential properties located along, adjacent to, or in the path of this mountain runoff are subject to recurring flooding and property damage. North of Baseline Road or the Western Canal, the study area is flatter and experiences street flooding and shallow flooding of low lying areas including some residential properties and industrial areas. Ponding along the Western and Highline Canals is also problematic particularly where the canal embankments are a barrier to the natural flow of water to the north and west. Flooding also occurs immediately downstream of the canals, particularly along the Highline Canal where flow overtops the canal. These flooding conditions are supported by historic complaints received by the City of Phoenix and many are evident from storm events as recent as July 2008 and July 2010.

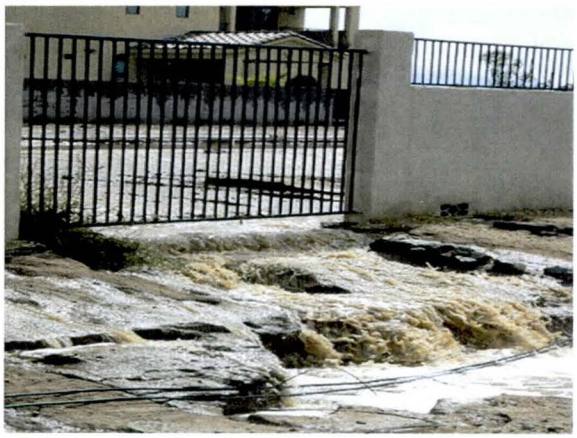
The need for flood control improvement and lack of adequate regional drainage and flood control facilities has been recognized in previous studies (Southeast Phoenix Storm Drainage Study, 1972), however, with the exception of the COP's storm drain system, no significant flood mitigation facilities exist. The Hohokam ADMS/ADMP will provide a comprehensive regional plan to address existing flood hazards and serve as a guide for future development and the planning of future flood control improvements.

7/31/10: 16th St & Highline Canal (SE from Gary Way)
From Fox News website: Flooding along 16th St and water spilling to the west down Gary Way.

7/31/10: 16th St & Highline Canal (east along canal)
Shallow flooding across canal. NE property flooded.

7/13/08: Cortland Point Subdivision
Cortland Point block wall failure along Highline Canal.

7/13/08: Cortland Point Subdivision
Flooding on Francisco Drive after storm. Ponding 1-1.5 feet in street.



7/31/10: Highline Canal along Pines at S. Mountain
Flow entering subdivision through openings in block wall provided to pass offsite flow from along the canal.

7/31/10: 14th St & Highline Canal
Flooding of property on 13th St just south of Circle K Park and Highline Canal (between 13th St and 14th St).

1.8 STORM DRAIN ASSESSMENT

With the exception of the 48th St. storm drain line which outfalls to the Tempe Drain, all study area storm drains outfall to the Salt River. Storm drain lines extend down all major north-south arterial streets from the Salt River or I-10 and upstream to Baseline Road. Laterals extending down many east-west major and minor arterial streets supplement the storm drain systems. With the exception of the 7th Avenue storm drain system, no storm drain system extends south of Baseline Road.

The storm drain assessment was based upon estimated pipe-full capacities of the existing storm drain pipes and flow captured by inlets modeled in the FLO-2D model. For the purpose of storm drain assessment, hydrology for the future conditions, 6-hour events were utilized. Overall, the existing storm drain system appears to be adequate for the 2-year event. For the 10-year event, much of the storm drain system appears to be adequate with the exception of main lines on 40th St. and 16th St. For the 100-year event, the storm drain system is generally inadequate with the exception of the North 16th St. mainline (separate system from the 16th St. main line) and the 48th St. main line. The results of the storm drain capacity assessment are summarized in Table 1-1.

Table 1-1: Summary of Storm Drain Assessment

Main Line	100-Year	10-Year	2-Year
19th Avenue	Not adequate Broadway - Atlanta	Adequate	Adequate
7th Avenue	Not adequate	Adequate	Adequate
Central Avenue	Not adequate Limits placed on upstream pipes & laterals due to lack of downstream pipe capacity	Likely adequate. (no negative system flows, but limits are reached upstream. Capacities might be exceeded if limits removed.)	Adequate
7th Street	Not adequate. Roeser - Southern	Generally adequate. Minor under-capacity in one pipe	Adequate
16th Street	Not adequate	Not adequate Southern – Roeser	Adequate
N 16th Street	Adequate	Adequate	Adequate
24th Street	Not adequate Vineyard - Southern	Adequate	Adequate
32nd Street	Not adequate	Generally adequate. (minor negative system flow but limits reached in upstream pipes)	Adequate (no negative system flows and no limits exceeded)
40th Street	Not adequate	Not adequate. (no negative system flows but limits reached on nearly all pipes)	Adequate (no negative system flows and no limits exceeded)
48th Street	Generally adequate. Minor under capacity in one pipe	Adequate	Adequate
Basis of assessment based upon future land use, 6-hour conditions.			

1.9 IDENTIFIED FLOOD HAZARD AREAS

The identification of flood hazards in the study area is the result of multiple sources. Existing FEMA floodplains identify existing regulatory flood hazards. Drainage complaints lodged with the municipalities or received directly from residents from public meetings helped identify more detailed and specific problem areas. These complaints were investigated as part of the Data Collection Report to identify whether the issues were attributed to local conditions or more regional in nature. In addition, FLO-2D simulations substantiate the existence of existing known problem areas and identify potential flooding sources. The model results also helped identify other potential hazard areas that may not have been identified through the drainage complaints received. Utilizing these sources, 21 flood hazard areas were identified. These areas were subsequently grouped into eight large areas for purposes of the Phase I brainstorming sessions (see Figure 1-2).

1.10 CLASS I SURVEY SUMMARY

The Class I Cultural Resources survey of the study areas indicated that more than 200 surveys have been completed within the study area. Collectively, these surveys encompass 616 acres, or approximately 4 percent of the study area. Archaeological surveys identified 112 prehistoric and historic cultural resources. Prehistoric sites span the length of the Hohokam occupation in the Phoenix Basin. The types of sites range from artifact scatters and petroglyph sites, to agricultural sites associated with canals and field houses, to large village sites with cemeteries. The historic period sites include canals (Roosevelt Canal, Western Canal, San Francisco, Hayden, and North Branch Highline), multiple spurs of the Southern Pacific Railroad (Welton-Phoenix-Eloy and Tempe-West Chandler), and cemeteries, as well as artifact/trash scatters with and without features, and buildings.

The majority of previously recorded cultural resources have not been evaluated for their NRHP eligibility. Three historic properties are listed in the NRHP including the Niels Peterson House, the Phoenix Carnegie Library and Park, and the Ralph H. Stoughton Estate. Eight other cultural resources and five sites have been previously determined eligible for inclusion in the NRHP. For the remainder of the identified cultural resources, 4 were recommended for testing to determine NRHP-eligibility, 45 were recommended NRHP-eligible, and 60 are unevaluated or of unknown eligibility.

If existing or newly recorded NRHP-eligible cultural resources could be affected by drainage improvements, these resources shall be treated in a manner consistent with the Secretary of the Interior's Guidelines for the Treatment of Historic Properties, applicable Arizona statutes, and City of Tempe and City of Phoenix regulations.

1.11 CSFHM INVENTORY & ANALYSIS

The District's Context Sensitive Flood Hazard Mitigation (CSFHM) Planning and Design Approach was implemented as a part of the Hohokam ADMS. The CSFHM Approach is designed to serve as a framework and tool for the development of flood hazard mitigation plan alternatives that integrate the three basic required functions of being acceptable to local communities, compatible with landscape resources and effective in reducing flood losses. A context sensitive solution is one that is capable of performing all three of these basic functions.

The CSFHM model examines the relationship between three contexts: Community, Land & Resources, and Flooding. The Community Context was defined in this study based upon an analysis an inventory and analysis of the direction and vision contained in local community plans (see Section 6.1) and public sensing. The Land & Resources Context was defined, by the District, through an inventory and analysis of the valued characteristics of landscape resources that included scenery, recreation, and open spaces. The Flooding Context was defined through an analysis of flood hazards and public exposure to flooding. These analyses were utilized to identify the range of flood hazard mitigation structure types, structural methods, and landscape design themes (refer to Table 1-2) that are capable of simultaneously performing all three functions of a context sensitive solution.

The range of solutions that were identified through the application of the CSFHM Approach, served as the building blocks for development of context sensitive plan alternatives during the alternatives formulation stage of the study. The CSFHM analysis of the three contexts was also utilized as a baseline for evaluating the context sensitivity of the Brainstormed and Phase II Alternatives during the alternatives evaluation stage of the study.

Table 1-2: Components of Flood Hazard Mitigation Solutions

Structural Types	Structure Methods	Landscape Themes
• Natural Structure • Underground Pipe • Channel Levee • Conveyance Channel • Storage Basin • Dam	• Natural • Soft Structural • Semi-Soft Structural • Enhanced Hard Structural • Semi-Hard Structural • Hard Structural	• Natural Sonoran Desert Upland • Natural Sonoran Desert Upland Riparian • Natural Lower Sonoran Desert • Natural Lower Sonoran Desert Riparian • Natural Sonoran Desert Hydro Riparian • Semi-Natural Sonoran Desert • Enhanced Desert • Desert Park • Desert Oasis • Urban Plaza

1.11.1 Community Context

The following is a summary of the flood hazard mitigation structure types, structural methods, and landscape design themes that were identified as acceptable based upon the inventory and analysis of the Community Context:

Structure Type Acceptability. All structure types except for a dam were determined to be acceptable throughout most of the study area (see Figure 6-2). In open space and park areas, all structure types would be acceptable with the exception of a channel levee and a dam. All structural types would be acceptable in areas comprised of heavy commercial and industrial land uses which may be found in the eastern portion of the study area.

Structural Methods Acceptability. Throughout the study area, the natural, soft structural, and semi-soft structural methods were generally determined to be acceptable (see Figure 6-3). Hard structural methods would be acceptable only in limited areas.

Landscape Themes Acceptability. Throughout most of the study area, all landscape themes would be acceptable except Natural Sonoran Desert Hydro Riparian and the Urban Plaza (see Figure 6-4). In the South Mountain area, the acceptable themes are limited to the Natural Sonoran Desert themes while generally most themes except the Natural Sonoran Desert Upland and Natural Sonoran Desert Upland Riparian themes would be acceptable.

1.11.2 Land and Resource Context

The following is a summary of the flood hazard mitigation structure types, structural methods, and landscape design themes that were determined to be compatible with landscape resources based upon the analysis of the Land & Resources Context:

Structure Types Compatibility. Natural structures are the only flood hazard mitigation structure types that are compatible within the floodway and flood fringe of the Salt River as well as the slopes of South Mountain (Figure 6-5). All structure types would be compatible over the majority of the study area, and in a few areas, all of the structure types, except for dam structures would be compatible with the land and resource context.

Structural Methods Compatibility. Similar to the structural types, natural is the only structural method that is compatible within the floodways, flood fringe areas, and the slopes of South Mountain (Figure 6-6). The Semi-Soft, Soft, and Natural Methods are compatible for a majority of the study area. Hard Structural Method is compatible in areas of heavy commercial or industrial use which are mostly located in the northern and eastern portions of the study area. All of the structural methods are compatible within the industrial valley plain landscape units.

Landscape Design Theme Compatibility. The Natural Sonoran Desert Uplands and Riparian landscape design themes would be compatible within the South Mountain area (Figure 6-7), while Natural Lower Sonoran Desert Riparian and Hydro-riparian landscape design themes would be compatible in areas along the Salt River. Within the developed areas throughout most of the study area, landscape design themes including the Semi-natural Desert, Enhanced Desert, Desert Park, Oasis and plaza themes would be compatible.

1.11.3 Flooding Context

The following is a summary of the flood hazard mitigation structure types, structural methods and landscape design themes that were determined to be effective in reducing flood losses based upon the analysis of the Flooding Context:

Effective Flood Control - Structure Types. All structure types except a natural structure would be considered effective over the majority of the area (see Figure 6-8). In the areas of riverine flow, underground pipe, channel levee and conveyance channels would be considered the most effective flood control structure types. In the South Mountain area, all structure types would be effective.

Effective Flood Control - Structural Methods. The simplicity of the drainage patterns and flooding types leads to a simple solution for developing effective flood control methods (see Figure 6-9). Except within the South Mountain Park, all flood control methods except a natural method could be effective. Within South Mountain Park all methods would be considered effective.

Effective Flood Control - Landscape Themes. For landscape themes, only the limited riverine flow areas would have some limitations on themes for the flooding context (see Figure 6-10). In those areas the Natural Sonoran Desert Upland and Upland Riparian Themes as well as the Desert Oasis and Urban Plaza themes would not be considered effective. Throughout most of the study area, all themes except the two natural Sonoran Desert themes would be considered effective for the flooding context. In the South Mountain Area, all landscape themes would be effective.

1.11.4 CSFHM Analysis and Results

In the final step of the application of the CSFHM Approach, the Comparative Analysis, information from the analysis of the Community, Land & Resources and Flooding contexts were combined, using GIS, to reveal flood hazard mitigation solutions (structure types, structural methods and landscape design themes) that are capable of concurrently meeting all three functional requirements of a context sensitive solution (see Figure 6-11). The following is a summary of the Structure Types, Structural Methods, and Landscape Design Themes that are context sensitive within discreet geographic areas of the project study area:

Context Sensitive Structure Types. The Underground Pipe, Channel Levee, Conveyance Channel and Storage Basin Structure Types will be context sensitive in most parts of the study area (see Figure 6-12). Only the Natural Structure Type will be context sensitive on the slopes of South Mountain.

Context Sensitive Structural Methods. The Natural, Soft, and Semi-Soft Structural Methods will be context sensitive in most parts of the study area (see Figure 6-13). The Enhanced Hard Structural Method will also be context sensitive within the North and Eastern parts of the study area and along some arterial streets.

Context Sensitive Landscape Design Themes. The large number of landscape design themes creates a somewhat complex array of landscape themes that would be context sensitive and part of a flood control solution. However, there is generally a good selection of landscape themes that would be considered context sensitive in most areas so that the landscape design would have the flexibility to meet a variety of site specific landscape conditions. In general the Natural Sonoran Desert Upland and Upland Riparian themes would be context sensitive in the South Mountain area (see Figure 6-14). Semi Natural Sonoran Desert, Enhanced Desert and Desert Oasis would be context sensitive in the bajada areas at the base of the mountain. For most of the study area, the Natural Lower Sonoran Desert themes, the Semi-natural Sonoran Desert, enhanced Desert and Desert Park would be context sensitive.

1.12 BRAINSTORMING ALTERNATIVES

Project team members, additional District personnel, and project stakeholders were invited and participated in the Phase I Brainstorming session. For purposes of the brainstorming session, eight areas were delineated based upon the identified flood hazards areas and potential source of the flooding issues (see Figure 1-2). At the session, the results of the data collection effort were provided including the general plans, cultural and land resources, study area opportunities and constraints and the results of the Landscape Inventory Analysis performed by the District. The results of the FLO-2D analyses were also presented including a FLO-2D animation to help define the problem areas and show potential flooding sources and contributing drainage areas. Participants were then divided into six working groups with each group assigned a brainstorming area with the exception of one group (Group 6) that was assigned three (Areas 6A, 6B and 6C). The groups then brainstormed ideas to address the flooding issues and presented them to the entire project team.

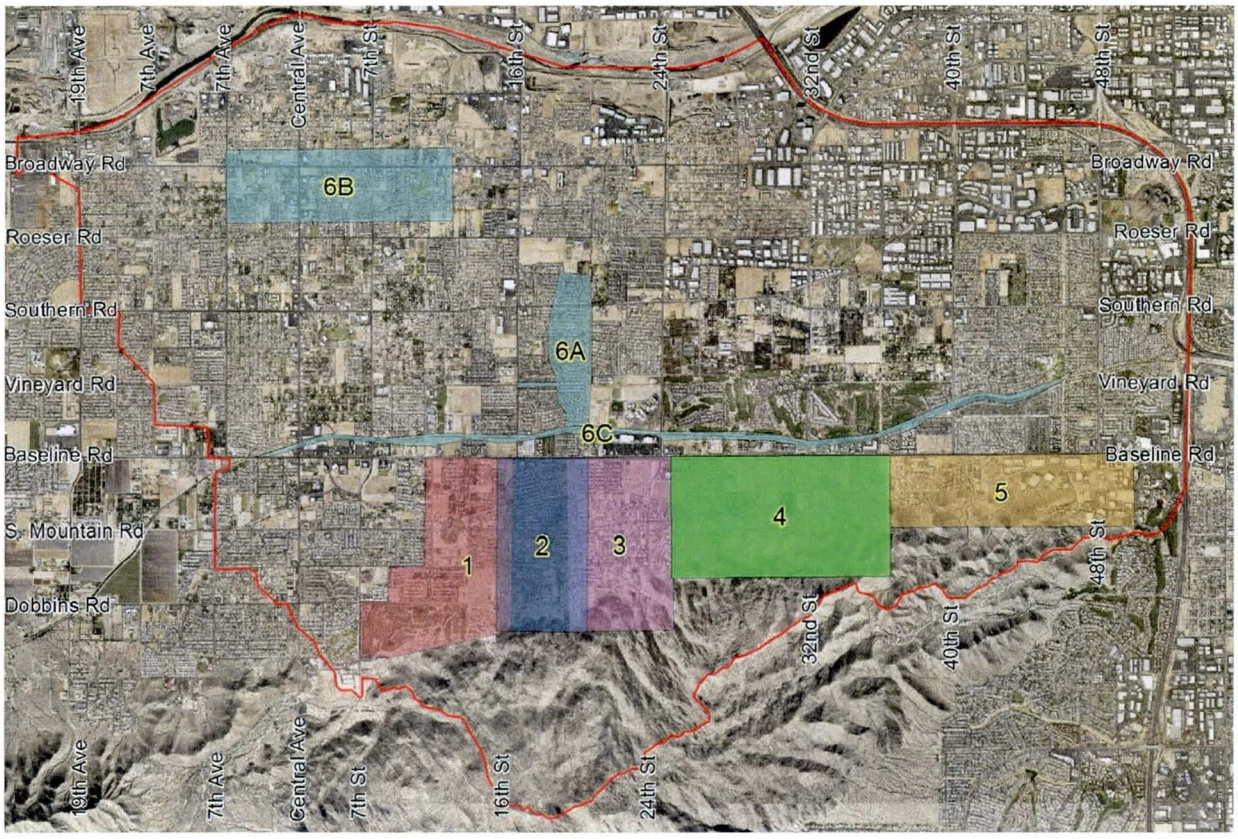


Figure 1-2: Brainstorming Areas

Alternatives developed during the brainstorming session are summarized below. Alone, the specific concept summarized may not achieve the desired flood mitigation but may be proposed as a component of an alternative comprised of multiple concepts.

1.12.1 Area 1: 7th St – 16th St (Circle K Park)

1) Dobbins Rd Channel: Channel east-west along Dobbins Road as a means to capture and convey mountain runoff (9th St to 20th St)

2) 16th St/Dobbins Basin: Basin in vacant parcel northwest of 16th St and Dobbins

3) Basin south of Circle K Park: Purchase low density residential parcels south of the park for a basin

4) Circle K Park Basin: Rebuild/regrade Circle K Park to provide retention

5) Basin Northwest of Circle K Park: Basin in vacant parcel north of Highline Canal and west of park

6) Siphon under Highline Canal: Construct siphon under Highline canal (to convey floodwater to above basin north of Highline Canal)

7) Improvements to be included as part of golf course development: Require/work with future development of Thunderbird Country Club Golf Course/Vistal Development to assure and possibly to provide additional improvements for area flood mitigation (retention, channel)

8) Dobbins/20th St Basins: Basin in vacant area southeast of Dobbins/20th St (south of Siesta Foothills)

1.12.2 Area 2: 16th St – 20th St (Siesta Foothills/Boy Scout Camp)

1) Boy Scout Camp Basin System (Eastern System):
   a) Capture Boy Scout Camp Wash flows into a basin southeast of Dobbins
   b) Convey to a larger basin
   c) Convey from basins via new storm drain in 20th St.
   d) Scalp peak with basins on either side of 20th St (or Highline Canal) subject to Baseline storm drain capacity

2) 16th St Basins and Storm Drain (Western System):
   a) Basin upstream of Dobbins at 16th St
   b) Route flows from basin under Dobbins via pipe to a basin northwest of 16th St and Dobbins (southeast of Euclid & 14th St).
   c) Discharge basin into storm drain along 16th St
   d) Discharge storm drain to Baseline Rd storm drain

3) Boy Scout Camp Offline Basin System (Eastern System):
   a) Offline basin to boy Scout Camp Wash flows
   b) Convey westerly via channel to Western System Alternative (above)

4) Boy Scout Camp Offline Basin System 2 (Eastern System):
   a) Offline basin to boy Scout Camp Wash flows
   b) Convey flow by storm drain to along Euclid and west to storm drain system in 16th St.

1.12.3 Area 3: 20th St – 24th St (Pines at South Mountain)

1) String of Pearls System: Series of channel and basins along the existing flow path west of 23rd Pl. Take flow to basins at northwest corner of 24th St / Highline Canal.

2) Highline Canal Channel: Channel to deliver flow to a basin(s) at northwest corner of 20th St / Highline Canal and/or at northwest corner of 24th St / Highline Canal

3) Dikes along base of mountains: Dike system along base of mountains

4) Channel along base of mountains: Channel system along base of mountains

5) Mountain Dam: Dam across major flow west of 24th St in mountains.

6) Dam at 24th St: Dam at 24th St and Euclid

7) Canal Storm Drain System: Storm drain system parallel to Highline Canal. Discharge to extensions of the existing storm drain system south of Baseline Rd.

8) East String of Pearls: Series of basins that delivers flow to a big basin at Baseline and 24th St.

9) Increase park retention: Enlarge existing retention in park

10) Move/Remove Houses: Move all houses.

11) Spillways from Highline Canal: Provide spillways in Highline Canal to detention basins.

1.12.4 Area 4: 24th St – 36th St (Cortland Point)

1) 28th St & South Mountain System:
   a) Basins south of Winston
   b) Outfall storm drain 27th St to South Mountain Ave
   c) Collector storm drains in South Mountain Ave
   d) Outfall basins at Puerto Park

2) 32nd St & Highline Canal System:
   a) Bleed-off storm drain to 24th St storm drain
   b) Collector storm drain at South Mountain Ave from 30th St to 32nd St
   c) Collector storm drain on south side of Highline Canal from 34th St-32nd St
   d) Outfall storm drain and basin at 32nd St (basin west side of 32nd St north of Highline Canal.)
   e) Bleed off storm drain on 32nd St north to Baseline

3) 36th St & Highline Canal System:
   a) Small basins along the Highline Canal to either the north or south side from 34th Pl to 36th St
   b) Channel/floodwall on north side of Highline Canal from 34th Pl to 36th St outfalling to basin(s)
   c) Outfall storm drain north in 36th St to Baseline then west in Baseline to 32nd St storm drain.

1.12.5 Area 5: 36th St – 48th St (South Mountain Industrial Area)

1) 42nd St or 42nd Pl / Baseline Basin: Basin at end of wash south of Baseline. Bleed off to existing storm drain in Baseline. Potential multi-use opportunity as a trailhead for park

2) Basin at Beverly Road South of Highline Canal: Basin southwest of 14th St and Vineyard

1.12.6 Area 6A: 16th St – 20th St (North of Western Canal)

1) Storm Drain: Provide a storm drain system along 18th St, 20th St and/or Vineyard to capture flows.

2) 16th St / Vineyard Basin: Basin in undeveloped area west of 20th St & south of Vineyard (undeveloped property belonging to South Mountain Community College)

3) 14th St / Vineyard Basin: Basin southwest of 14th St and Vineyard

4) 16th St / Vineyard Basin; Basin northwest of 16th St and Vineyard

1.12.7 Area 6B: 3rd St & Broadway (Low Laying Area)

1) Multiple Small Basins: Provide retention in available vacant parcels in general areas that bleed to the storm drain on Broadway or Central

2) Extend/expand storm drain into/in the area to alleviate flooding (and bleed basins): Extend the storm drain systems from Central and/or Broadway into area to capture flows and provide a means to bleed off multiple small retention basins.

1.12.8 Area 6C: Ponding along the south side of Western Canal

1) Basins along south side of Canal: Provide a storm drain system along 18th St, 20th St and/or Vineyard to capture flows.

2) No Action: Expectation that improvements upstream would address and/or alleviate ponding along the canal.

1.13 SEED IDEAS

Prior to the brainstorming session, 48 seed ideas were conceived for the twenty one flood hazard locations and also to address more systemic problems such as storm drain deficiencies, flooding along the Highline Canal and future development. These seed ideas were not presented to the brainstorming participants as part of the brainstorming session, so as not to influence or bias potential ideas generated by the attendees. Many of the seed ideas were similarly envisioned by the brainstorming groups, however, some were not, and consequently the seed ideas are included for further assessment during Phase II. A table is provided in Appendix C that briefly describes the seed idea and then shows which problem areas the idea would address and the nature of the impact on the flooding location.

1.14 LEVEL 1: ALTERNATIVE FORMULATION

For Level 1, the developed brainstorming and seed ideas generated in Phase I will be utilized, in part or in their entirety, to develop more comprehensive alternatives for each problem area to be evaluated for further consideration in Level 2. The preliminary analysis and evaluation of alternatives will be based upon information available from the Phase I hydrologic & hydraulic analyses and other data collection efforts. A preliminary evaluation matrix will be developed and used to help assess and identify alternatives for further development and assessment in Level 2.

2. INTRODUCTION

2.1 PROJECT DESCRIPTION, PURPOSE & GOALS

The Hohokam Area Drainage Master Study/Plan (ADMS/ADMP) is a two-phase regional flood control planning project to determine the nature and magnitude of existing flood hazards; develop and evaluate potential flood mitigation alternatives; provide preliminary design plans for recommended improvements; and ultimately provide a comprehensive plan to address flooding within the study area and guide future development and flood control improvements.

This report documents Phase I, the Hohokam Area Drainage Master Study (ADMS). The Hohokam ADMS is a comprehensive data collection and investigation effort to identify and quantify existing and potential future flood hazards and document archeological, cultural, landscape, and recreational resources and opportunities that will serve as the basis to formulate and assess mitigation alternatives. The effort includes development of hydrologic/hydraulic models to simulate flooding conditions; data collection and site investigations; and public outreach to gather essential information on existing flooding conditions and to incorporate the issues, concerns and values of the public into the decision making process. In addition, stakeholder involvement and participation is included to inform significant area stakeholders, facilitate the data collection effort and to identify potential opportunities for flood control improvements.

Phase II, the Hohokam Area Drainage Master Plan (ADMP), will utilize the results of the ADMS to formulate flood mitigation alternatives and through three levels of alternative development, analysis and evaluation, ultimately make recommendations for study area improvements. The ADMP will expand upon the public outreach and involvement efforts and develop concept plans for recommended improvements. Recommended improvements will be prioritized and a strategy for implementation prepared.

2.2 PROJECT AUTHORIZATION

The Flood Control District of Maricopa County (FCDMC) authorized the performance of the Hohokam ADMS/ADMP under contract FCD 2009C029 with an effective Notice-to-Proceed date of May 12, 2010.

2.3 PROJECT LOCATION

The Hohokam ADMS/ADMP study area is located within the corporate limits of the City of Phoenix and the City of Tempe. The area is approximately 28.1 sq. miles in size and bounded by the I-10 to the north and east, the Salt River to the north, South Mountain Park to the south and the Laveen ADMS to the west (see Figure 2-1).

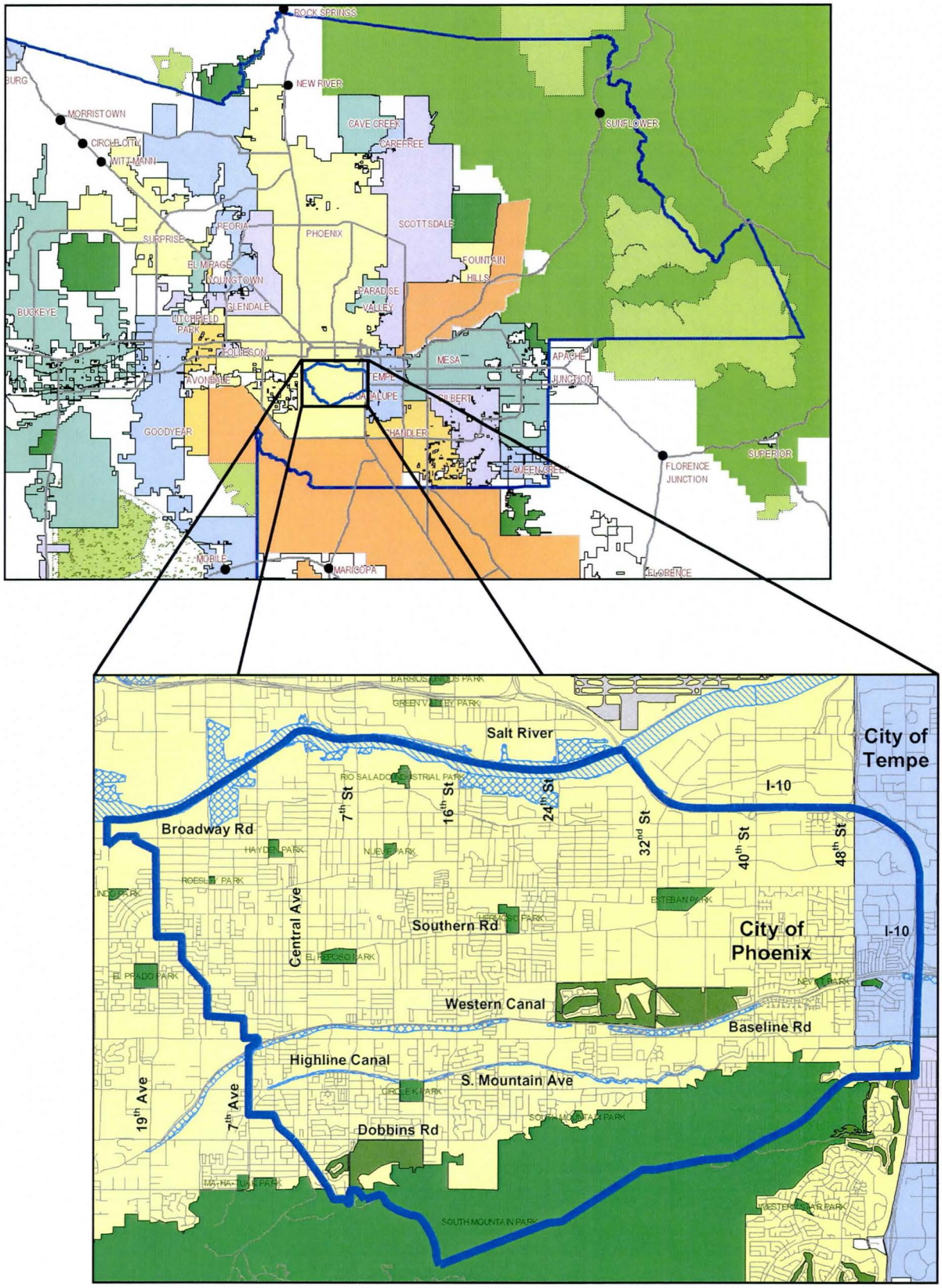


Figure 2-1: Project Location and Vicinity Map

2.4 PROJECT OVERVIEW AND HISTORY

The Hohokam study area is located north of South Mountain in south Phoenix and western Tempe. Being located along the Salt River, the area has a long history of agricultural cultivation dating back to the Hohokam culture over 500 years ago. Possibly due the area's extended history of agriculture and its gradual urban conversion, no continuous natural washes remain to drain the watershed to the Salt River, nor are there any continuous manmade conveyances except as provided by the City's storm drain system. Among the most significant features in the watershed are the SRP's Western and Highline Irrigation Canals. The canals are roughly parallel to each other, draining from east to west across the study area and approximate flood hazards have been delineated along the canals due to the disruption of the natural pattern of flow to the north and west from South Mountain to the Salt River and ponding behind the canals.

During intense storm events, the flatter lower portion of the study area (roughly north of the Western Canal) experiences more widespread shallow flooding in the streets and low laying areas. The steeper upper portion of the watershed located along the foothills of South Mountain is directly impacted by runoff from the South Mountain and experiences more intense concentrated flooding along streets, remnant washes and historic flow paths. These flooding conditions are documented in historic complaints received by the City of Phoenix and evident from recent storm events including July 2008 and July 2010.

Lack of adequate regional drainage and flood control facilities has previously been recognized. The most comprehensive study of the area was the Southeast Phoenix Storm Drainage Study conducted in 1972. This study provided conceptual design of large diameter storm drain trunk lines down the major north/south arterial streets and also recommended the construction of several regional detention basins located upstream of the Highline Canal. While storm drain lines have been constructed along the major arterial streets from the Salt River to Baseline Road, with the exception of a large basin location on Central Ave, at the entrance to South Mountain Park, the recommended detention basins were never constructed.

In 1997, a similar study, the South Phoenix-Laveen Drainage Improvement Project, was conducted that included the portion of the Hohokam study area west of Central Avenue. Similar recommendations were made (storm drain and regional detention), however, the focus was primarily on drainage issues in the Laveen area and few improvements were proposed within the current Hohokam study area.

2.5 HOHOKAM ADMS REPORTS

Several reports have previously been prepared as part of the Hohokam ADMS. These previous reports include:

2.5.1 Hohokam ADMS Data Collection Report

The Data Collection Report documents and summarizes the data collection effort and presents pertinent data collected for the Hohokam ADMS. The report includes:

- Landscape Inventory Analysis
- Context Sensitive Flood Hazard Mitigation Planning and Approach
- Study Area General Plans and Specific Plans (summarized)
- Study Area Drainage Complaints and Site Investigations
- Study Area FIRMs
- Summary of Previous Study Area Reports
- Public Meeting Comments.

2.5.2 Class I Cultural Resources Inventory Survey

The Class I Cultural Resources Inventory Survey of 16,000 acres for the Hohokam Area Drainage Master Plan documents the results of Logan Simpson Designs (LSD) investigative effort into the cultural resources within the study area and beyond it limits for 1 mile.

2.5.3 Pilot Study & Sensitivity Analysis Drainage Memorandum

The Drainage Memorandum documents and summarizes the results and conclusions of the FLO-2D pilot study. The pilot study consisted of hydrologic modeling of a smaller representative portion of the Hohokam ADMS study area for the purpose of determining the methodologies and approaches to be used for the development of the final study models for the entire study area. As part of the pilot study, sensitivity analyses were performed to assess the impact of various hydrologic parameters, model variables and hydraulic features. The recommendations of the pilot study were not necessarily adopted in the final study models due to further refinement of the modeling process and FLO-2D software.

2.5.4 Hohokam ADMS Hydrology & Hydraulics Report

The Hydrology and Hydraulics Report documents the assumptions, approaches and results of the study area FLO-2D hydrologic models and hydraulic analyses. It includes a discussion of the model verification efforts, identification of potential problem areas, and provides an assessment of the study area storm drain system based upon the FLO-2D analyses and full-pipe capacity approach used for the study.

2.6 PROJECT PARTICIPATION

The FCDMC and the City of Phoenix (COP) are the primary agencies intimately involved in project activities. The consultant team included staff members from Stanley

Consultants Inc. (SCI), JE Fuller Hydrology and Geomorphology (JEF), Logan Simpson Design (LSD), Riada Engineering (RE) and RG Engineering Services (RG).

2.6.1 Study Contacts

In addition to the primary agencies and project team, the following list of study contacts and stakeholders were instrumental in the collection of project data and the conduction of project activities.

City of Phoenix

Engineering Records
200 W Washington, Phoenix, AZ 85003

Neighborhood Services
200 W Washington, Phoenix, AZ 85003
Contact: Ray Buchanan (602) 534-2274

Parks & Recreation
200 W Washington, Phoenix, AZ 85003
Contact: Mike Bornhoeft (602) 262-4925

Street Transportation Department – Floodplain Management
200 W Washington, Phoenix, AZ 85003
Contact: Hasan Mustaq (602) 262-4026

Street Transportation Department – GIS
200 W Washington, Phoenix, AZ 85003
Contact: Robert Marsh (602) 534-1552

Village Planning – South Mountain
200 W Washington, Phoenix, AZ 85003
Contacts: Joshua Bednarek (602) 262-6823

City of Tempe

Public Works Department - Engineering Division
31 East Fifth St, Tempe AZ 85281
Contact: Donna Sullivan-Hancock (480) 350-8341

Public Work Department – Neighborhood Services Division
31 East Fifth St, Tempe AZ 85281
Contact: Elizabeth Thomas (480) 350-8223

Flood Control District of Maricopa County (FCDMC)

GIS Branch
2801 W Durango St Phoenix AZ 85009
Contact: Eric Feldman (602) 506-8736

Hydrology/Hydraulics Branch
2801 W Durango St Phoenix AZ 85009
Contact: Julie Cox (602) 506-8401

Engineering Special Projects Branch
2801 W Durango St Phoenix AZ 85009
Contact: Tom Loomis (602) 506-4767

Maricopa Association of Governments (MAG)

302 N 1st Ave, Phoenix AZ 85003
Contact: Tim Strow (602) 254-6300

Salt River Project

Water Engineering
P.O. Box 52025, Phoenix AZ 85072-2025
Contact: Bob Gooch (602) 236-5227

Northside Water O & M
P.O. Box 52025, Phoenix AZ 85072-2025
Contact: Dave Kieffer (602) 236-4954

Southwest Gas

10851 N Black Canyon Highway, Phoenix AZ 85029-4755
Contact: Greg Cooper (602) 484-5276

Valley Metro/Metro Light Rail

101 N 1st Ave, Suite 1100, Phoenix AZ 85003
Contact: Robert Forest (602) 322-4514

2.6.2 Stakeholders

In addition to assisting in the data collection effort, stakeholders provided input regarding their concerns and shared information on existing, ongoing and future projects in the study area.

City of Phoenix (COP)

The COP has jurisdictional authority over most of the study area including South Mountain Park. In addition to the Street Transportations – Floodplain Management Department, other city departments are considered area stakeholders including neighborhood services, parks & recreation, and planning.

The Street Transportation – Floodplain Management Department provided 32 flooding complaints received by the city dating back to before 2000. In addition, the city provided an Emergency Storm Report for a July 31 to August 1, 2010 storm event. This report identified 19 additional areas in which city personnel were deployed to address various storm related events ranging from vactoring/cleaning storm sewers/catch basins to debris removal from streets.

Among the COP's concerns are to remove, if possible, residents from identified flood hazard zones along the Western and Highline Canals by removing or reducing the floodplain limits. The COP is also interested in the capacity of the existing storm drain system to determine their effectiveness, capacities and identify potential deficiencies.

City of Tempe (COT)

The study area east of 48th St. is located within the COT. The city has provided information on the city's storm drain and assistance in identifying neighborhood contacts for purposes of public involvement. The city has no database that documents flooding complaints within the study area.

Salt River Project (SRP)

SRP operates and maintains both the irrigation facilities as well as the power utilities in the study area. SRP has provided operational information and access on its irrigation facilities. SRP expressed interest in the approaches being used to model their irrigation facilities, primarily the Western and Highline Canals, and have recommended that any models consider the canals to be at bank full capacity.

Arizona Department of Transportation (ADOT)

ADOT holds jurisdiction within the ADOT ROW along the I-10 corridor. ADOT expressed no significant concerns with the Hohokam ADMS. ADOT currently is conducting a Design Concept Study and Environmental Impact Study (EIS) for improvements along the I-10 corridor from SR51 to SR202. Concept designs are due in the spring of 2012 and proposed for construction in 2013. Proposed improvements will not have a significant impact on the Hohokam ADMS.

ADOT, the COP and the COT have an intergovernmental agreement (IGA) for discharges to the Tempe Drain, the outfall for the 48th St storm drain line and the only

outfall that is not to the Salt River. The IGA stipulates the maximum amount of flow each agency can discharge into the Tempe Drain.

Valley Metro

Metro Light Rail will be conducting a feasibility study to extend a Metro Light Rail line into the South Phoenix area in the future. It is not foreseen that the study or any potential feasible alignments will be adequately completed or defined to consider in the Hohokam ADMS/ADMP. The most likely alignment for any extension would likely be along a Central Avenue corridor.

2.7 INTERAGENCY COORDINATION

2.7.1 City of Phoenix (COP)

The City of Phoenix primary concerns are to identify potential inadequacies in the COP storm drain system, define existing flood hazards and to address known flooding issues in the study area. In particular, those documented historically in flooding complaints and flooding issues in the upper portion of the study area related to mountain runoff and flooding along the Highline and Western Canals.

2.7.2 City of Tempe (COT)

The City of Tempe has no existing drainage facilities in the study area and has not data base or record of drainage complaints lodged within the study area. The COT, however, is interested in identifying potential flood hazards and drainage inadequacies.

2.7.3 Arizona Department of Transportation (ADOT)

ADOT has not expressed any specific concerns about flooding and/or drainage from the Hohokam study area. Interstate-10 which bounds the study area to the north and east is generally hydrologically separated from study area by raised earthen embankments and the freeway drainage infrastructure is generally isolated with the exception drainage to the Tempe Drain. ADOT, the COP and the COT have an intergovernmental agreement (IGA) that stipulates the maximum amount of flow each agency can discharge into the Tempe Drain. The Tempe Drain serves as the outfall for the 48th St storm drain line. Of potential concern might be any potential improvements to the 48th storm drain line that might increase discharge from the 48th St storm drain line above the rate stipulated by the IGA.

2.7.4 Salt River Project (SRP)

SRPs primary concerns involve the Western and Highline Canals. Flooding along the canals, primarily the Highline Canal, is problematic not only for maintenance and

operation but also from a public relations perspective. The Highline Canal intercepts offsite runoff along its length and is frequently overtopped during intense storm events. Overtopping of the canal causes erosion and is a continual maintenance issue in some areas. In addition, flooding issues downstream of the canal is often attributed to the canal itself and/or considered to be a contributing factor. SRP practice is to drain the Highline Canal prior to the onset of large storm events.

SRP expressed some concern that hydrology models might reflect that the canals provided flood storage and provide some attenuating effects. Consequently, the incisions of the canals themselves were removed from the model topography and the models reflect a wide flat ground surface at the elevation of the embankments.

3. EXISTING FACILITIES & ASSESSMENTS

3.1 WATERSHED & WASHES

The study area watershed generally drains to the northwest; from the South Mountains to the Salt River. Possibly due the area's extended history of agriculture and its gradual urban conversion, no continuous natural washes remain to drain the watershed to the Salt River, nor are there any continuous manmade conveyances except as provided by the COP's storm drain system. Storm water not captured by the storm drain system, retained in basins or impounded behind canals is carried overland and along surface streets.

The upper portion of the watershed (roughly south of the Highline Canal) is more steeply sloped and primarily residential developments. This area is directly impacted by runoff from the South Mountains. Some washes descend out of the mountains and continue through developed areas but they quickly dissipate and essentially disappear prior to the Highline Canal. The lower portion of the watershed (north of the Western Canal) is much flatter and surface drainage is almost exclusively carried overland or along streets.

3.2 REGIONAL RETENTION

Within the study area there are no large regional retention facilities owned by the FCDMC, the COP or the COT. The COP owns a large regional retention basin located at the entrance to South Mountain Park on Central Ave and just outside the study area. The basin is the outfall for a large watershed that extends south into South Mountain Park. An initial assessment of the retention basin's capacity and operation performed at the outset of the project determined that the basin had sufficient volume to retain the 100-yr, 6-hr and the 100-yr, 24-hr events and that any flow overtopping the basin would drain to the northwest to the Laveen Study Area. This retention basin is currently being studied in more detail with new mapping and survey as part of the District's South Phoenix Two Basins Project (FCD 2011C008). For the purposes of this project, the retention basin is not considered part of this study.

Small local retention basins are located throughout the study area; however, they are primarily constructed to meet development requirements for onsite retention. North (downstream) of the Highline Canal, some developments have designed open space for conveyance and retention to try to help control flow that might overtop the canal (e.g. Groves at South Mountain, Las Colinas, and Pines at South Mountain). However, two large retention basins are located in the Dobbins Creek subdivision (Dobbins Rd and 10th St). These basins provide onsite retention for the development but also retain mountain runoff that passes through the Thunderbird Country Club Golf Course (TCCGC). The TCCGC itself provides some additional retention.

3.3 STORM DRAIN SYSTEM

3.3.1 Existing Storm Drain System

With the exception of the 48th St storm drain line which outfalls to the Tempe Drain, all study area storm drain outfall to the Salt River. Storm drain lines extend down all major north-south arterial streets from the Salt River or I-10 and upstream to Baseline Road. Laterals extending down many east-west major and minor arterial streets supplement the storm drain systems. With the exception of the 7th Avenue storm drain system, no storm drain system extends south of Baseline Road (See Figure 3-1). ADOT, the COP and the COT have an IGA for flow discharges to the Tempe Drain, the outfall for the 48th St. storm drain line and the only outfall that is not to the Salt River. The IGA stipulates the maximum amount of flow each agency can discharge into the Tempe Drain. With the exception of the relatively minor drainage improvements constructed in conjunction with roadway improvement projects, there are no known plans to significantly upgrade or improve the existing storm drain system within the study area.

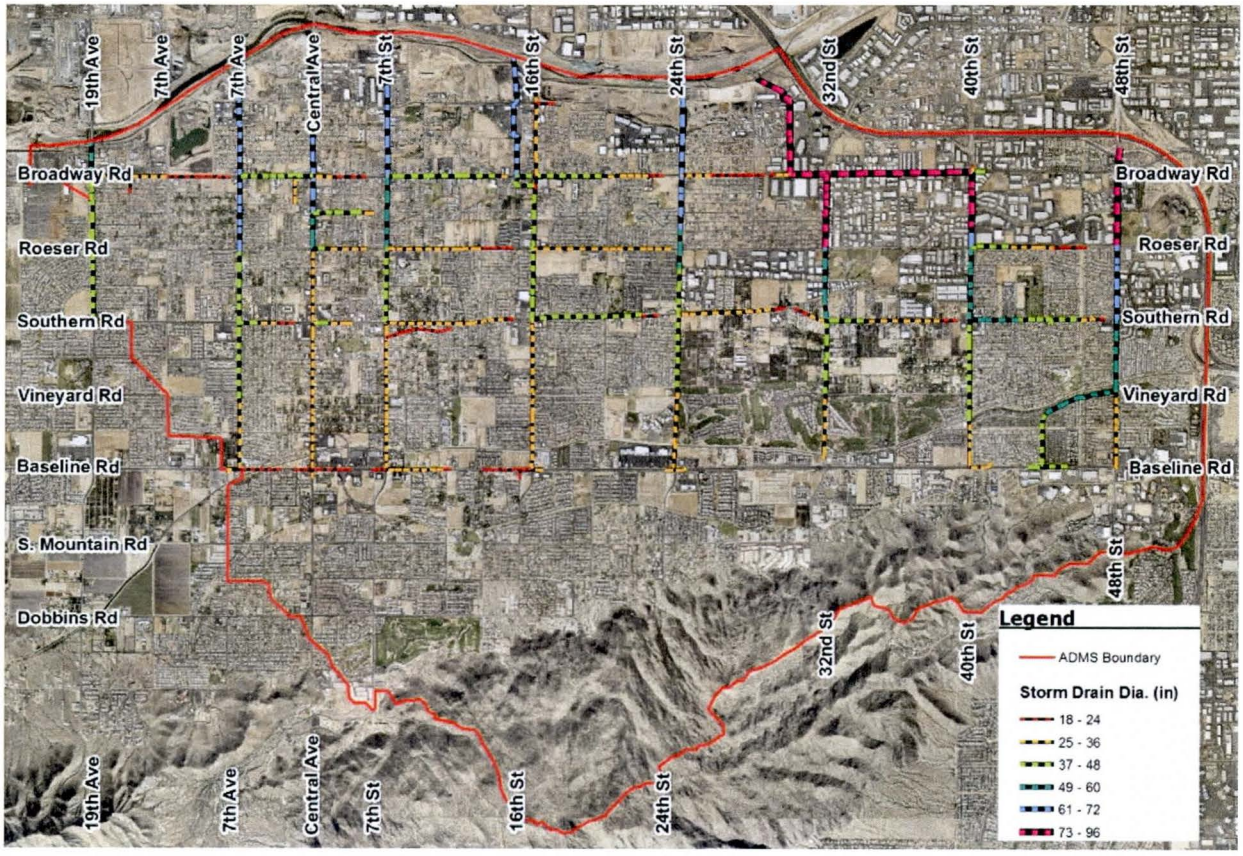


Figure 3-1: Study area storm drain system.

3.3.2 Assessment Considerations

There are a number of caveats when considering the storm drain assessments that follow. Most important is that FLO-2D is not currently well suited for integrated hydraulic/hydrologic modeling of complex storm drain systems and the approach used requires a number of important assumptions discussed in the Hohokam ADMS H&H Report. It is recommended that any subsequent project alternatives that include storm drain improvements either to address any perceived storm drain inadequacies and/or to serve as an outfall for flood mitigation alternative perform a more detailed hydraulic assessment of the impacted system utilizing more conventional hydraulic analyses and more accurate topographic data.

3.3.3 Storm Drain Assessment

Details of the storm drain capacity assessment are provided separately in the Hohokam ADMS Hydrology & Hydraulics (H&H) Report. The storm drain assessment was based upon estimated pipe full capacities of the existing storm drain pipes and flow captured by inlets modeled in the FLO-2D model. For purpose of storm drain assessment, hydrology for the future conditions, 6-hour events were utilized. Overall, the existing storm drain system appears to be adequate for the 2-year event. However, storm drain inadequacies arise for the 10-yr and 100-yr events. The assessments of the storm drain systems are briefly described in the sections below and summarized in Table 3-1.

3.3.3.1 2-Year Events

For the 2-year events, all storm drain systems have adequate capacity to convey the flow. No pipes exceed their estimated pipe capacity and where pipes are limited to less than their estimated pipe capacities, the captured flows are less than the capacity restriction placed on the pipes.

3.3.3.2 10-Year Events

For the 10-year events, the following systems were not fully adequate to convey flow under pipe full conditions:

- 7th Ave upstream of Roeser Rd.
- Central Ave downstream of Broadway Rd.
- 7th St has one pipe exceeding pipe full capacity but the magnitude is considered minor and the overall system could be considered adequate
- 16th St from Roeser Rd to Southern Ave.
- The pipes identified as the 32nd St main lines are adequate; however the large pipe diameter East Broadway Lateral (EBL) is not adequate. This lateral has 40th St as a contributing lateral.
- 40th St–East Southern Lateral and 40th St Main line from Baseline to Southern.

3.3.3.3 *100-Year Events*

For the 100-year events, the following systems were not fully adequate to convey flow under pipe full conditions:

- 19th Ave between Broadway Road and Atlanta Ave.
- 7th Ave
- Central downstream of Broadway Rd.
- 7th St between Roeser Rd. and Southern Ave
- 16th St
- 24th St between Vineyard Rd. and Southern Ave.
- 32nd St.
- 40th St.
- 48th St. exceeds pipe full capacity from Pecan Rd to Vineyard Rd. The magnitude is relatively small and the pipe could be considered to be adequate.

Table 3-1: Storm Drain Capacity Assessment

Main Line	2-Year	10-Year	100-Year
19th Avenue	Adequate	Adequate	Not adequate Broadway - Atlanta
7th Avenue	Adequate	Not adequate Upstream of Roeser	Not adequate
Central Avenue	Adequate	Not adequate Salt River – Broadway	Not adequate Limits placed on upstream pipes & laterals due to lack of capacity
7th Street	Adequate	Generally adequate. Minor under-capacity in one pipe	Not adequate. Roeser - Southern
16th Street	Adequate	Not adequate Southern – Roeser	Not adequate
N 16th Street	Adequate	Adequate	Adequate
24th Street	Adequate	Adequate	Not adequate Vineyard - Southern
32nd Street	Adequate (no negative system flows and no limits exceeded)	Main Line adequate but large diameter East Broadway Lateral not adequate	Not adequate
40th Street	Adequate (no negative system flows and no limits exceeded)	Not adequate	Not adequate
48th Street	Adequate	Adequate	Generally adequate. Minor under capacity in one pipe.
Basis of assessment based upon future land use, 6-hour conditions.			

4. IDENTIFIED FLOOD HAZARD AREAS

4.1 GENERAL

The identification of flood hazards in the study area is the result of multiple sources. Existing FEMA floodplains identify existing regulatory flood hazards. Drainage complaints lodged with the municipalities or received directly from residents from public meetings help identify more detailed and specific problem areas. In addition, FLO-2D simulations substantiate the existence of existing known problem areas and identify potential flooding sources. The model results also help identify other potential hazard areas that may not have been identified in drainage complaints.

4.2 FEMA FLOODPLAINS

Outside of the floodplain limits of the Salt River (Flood Hazard Zone AE), existing study area floodplains are approximately determined (Zone A) and located immediately upstream of the Western and Highline Canals. The remainder of the study area is located in shaded and unshaded Zone X. Flood Insurance Rate Maps (FIRMs) for the study area are provided in Appendix A.

4.3 HISTORIC FLOODING AND DRAINAGE COMPLAINTS

As part of the data collection effort, the COP provided an initial list of specific flooding complaints dating back to the early 1990's. These sites along with other flooding locations identified and obtained from public meetings were investigated to assess the nature and potential cause of the flooding or complaint and categorized as either local issues or regional issues. In addition, storm events during the course of the study provided additional information on problem flooding areas. For one storm even on July 31, 2010, the COP provided an emergency storm report identifying areas of reported storm flooding and the COP's response. The areas identified correlated well with the previously documented drainage complaint areas.

The results of the drainage complaint investigations are documented separately in the Hohokam ADMS Data Collection Report. An exhibit showing the location and nature of flooding/drainage complaints is provided in Appendix B. Based upon these complaints and the results of the FLO-2D analyses several general flooding problem areas were identified and presented to the participants in the Phase I Brainstorming Session.

4.4 PROBLEM AREAS DISCERNED FROM FLO-2D ANALYSES

Using FLO-2D results, potential problem areas were identified and numbered. These locations are shown in Figure 4-1, Figure 4-6 and Figure 4-9. Many of the identified problem areas are consistent with documented drainage complaints and areas with known drainage and/or flooding issues.

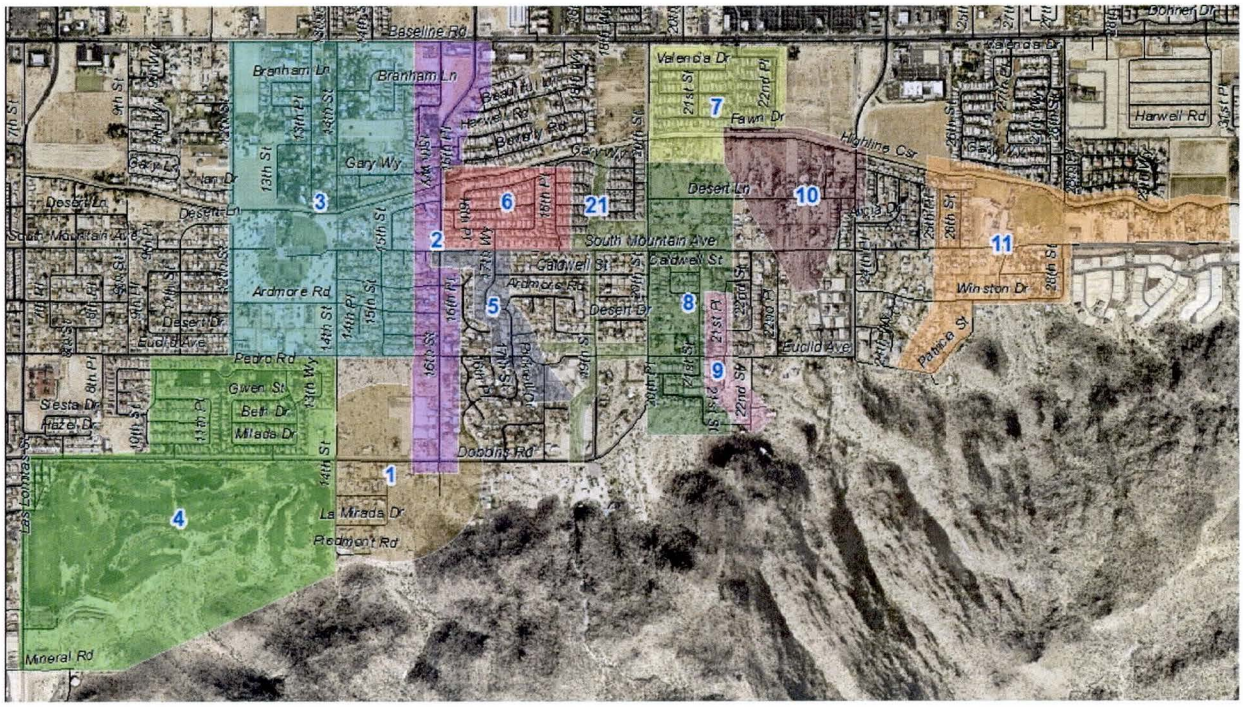


Figure 4-1: Identified Problem Areas in the Southwest Area

4.4.1 Area #1: Montana Vista Subdivision (16th St. & Dobbins Rd.)

This Montana Vista development located at the corner of 16th St and Dobbins is subject to mountain runoff from two separate drainage areas (see Figure 4-1). At the southeast corner of the development, a 10'x4' reinforced concrete box culvert (RCBC) with a grated inlet is provided to convey flow north through the development via the culvert and a rectangular channel downstream that extends as far as the development at which point unconfined flow continues northerly along 16th St.

The principal source of water is from the relatively small, eastern most drainage area that discharges to the intersection of 16th St and Dobbins. The western drainage area is much larger and drains north along 15th St to Dobbins and then either east to the 16th St intersection or into the Montana Vista development through the front entrance gates. Some flow does continue northwest overland towards 14th St and Circle K Park. The combination of these generally unconfined flows and the apparent inadequacy of the culvert contribute to the flooding within the development. A residential property located on Dobbins Rd., upstream of the culvert and another located on 16th St, downstream of

the culvert/channel and residential properties adjacent to 15th St, south of Dobbins may also be subject to potential flooding.

4.4.2 Area #2: 16th St. from Dobbins Rd. to Baseline Rd.

Flooding along 16th St has been documented and specifically a property just north of the Highline Canal and 16th St has been flooded to some extent twice in the past 3 years. Much of the drainage within 16th St. initially originates from the two mountainous drainage areas that impact the Montana Vista Subdivision at 16th St and Dobbins Rd. However, 16th St also receives flow from side streets (e.g. from South Mountain Ave to the east) and distributes flow to sides streets (e.g. Euclid Ave to the west) as it continues north towards Baseline Road (see Figure 4-1). The 16th St corridor is entwined with flooding and drainage issues at Circle K Park, Montana Vista, Highline Canal, Desert Lane, Gary Way, 15th Way, Branham Lane and possibly even 14th St and 15th St. The lack of a containing conveyance along 16th St. results in flow being distributed through the streets aggravating drainage conditions in these areas.

Figure 4-2: Flooding along 16th St during recent event.

4.4.3 Area #3: Circle K Park (14th St. & South Mountain Ave.)

Circle K Park itself appears to experience shallow flooding indirectly from mountain runoff overland, through streets (Euclid Ave, S. Mountain Ave. and 14th St) and from flow passing through the Dobbins Creek Retention Basins (see Figure 4-1). However, the concentration of flow along the east side of the park and the flow overtopping of Highline Canal at 13th and 14th St. is the area of most concern. Recent improvements have been constructed along the east boundary of the park that include a riprap lined inlet for street drainage, a wide shallow ponding area, concrete inlets to the canal and bridges across the canal and the inlets. Even prior to the constructed improvements, this location has documented historic flooding issues related to flow overtopping the canal. However, shortly after the construction of improvements, a block wall along the canal was undermined flooding the property(s) downstream of the canal. Though undermined, the wall itself did not fail during the event and does fail in any of the project

FLO-2D analyses. Flow overtopping the canal contributes to flooding issues along 13th Pl. and 14th St.

4.4.4 Area #4: Thunderbird Country Club G.C. (7th St. & Dobbins Rd.)

The Thunderbird Country Club Golf Course (TCCGC) is located south of Dobbins Rd between 7 St. and 14th St. (see Figure 4-1). Being located at the base of the mountain, the golf course receives a significant amount of runoff from the mountains. The golf course stores and attenuates some flow. Two separate 2-8'x4'culverts crossing Dobbins Rd. (called Dobbins Creek West 1 (DCW1) and East 1 (DCE1)) and discharge flow from the golf course to channels through the Dobbins Creek subdivision located immediately downstream and into two retention basins within Dobbins Creek. The basins discharge flow directly to Euclid Ave and continue north through residential properties and towards the Circle K Park.

The golf course area is identified as a problem area because it has a significant impact on area hydrology. Through the data collection effort, it became known that the parcel has already been rezoned and illustrative development plans have been submitted for the conversion of the golf course to a mixed use residential and resort development. A potential decrease in the retention/flow attenuation or increase in runoff volume provided by the golf course and even a change in the distribution flow between the two culverts crossing Dobbins Road could have significant impacts on the Dobbins Creek channels and retention basin and flows downstream of Dobbins Creek including residential properties and Circle K Park. Despite the culverts being the same size, FLO-2D results show the east culvert conveying a significantly more flow than the west culvert.

4.4.5 Area #5: S. Mountain Ave. & 17th Way

FLO-2D results indicate a significant amount of drainage and flooding from the intersection of 16th St and South Mountain Ave to Euclid and 17th Way (see Figure 4-1). The source of the floodwater is flow crossing the culvert on Dobbins Road at the Boy Scout Camp and diverted west at a downstream culvert in Mountainside Estates. Flow diverted west, overtops the road at 18th St and the natural drainage path takes flow down west down Euclid Ave., north along 17th Way and then west down South Mountain Ave to 16th St. Significant flow in the streets presents the potential for flooding of adjacent properties and contributes to flooding issues in Area 2 along 16th St.

4.4.6 Area#6: Vista Portica (17th Way & S. Mountain Ave.)

Vista Portica is a development located just upstream of the Highline Canal and east of 16th St. The developments sole retention basin is located at the northwest corner of the development and the southeast corner of 16th St and the Highline Canal (see Figure 4-1). A curb opening catch basin along 16th St, just prior to the Highline Canal, captures flow and discharges it into the basins. Overtopping of the basin and the blockage and accumulation of sediment in the catch basin along 16th St are persistent drainage

issues. Overtopping of the basin can be attributed to significant drainage to the retention basin not only from the development but also from offsite flows along 16th St; Highland Ranch (from the east via Francisco Dr), and South Mountain Ave (via 17th Way). Generally, documented complaints focus on the retention basin; however, it is possible that some residential properties might be subject to potential flooding due to flow from South Mountain Ave and overtopping of the basin.

4.4.7 Area #7: The Pines at South Mountain (21st Way & Baseline Rd)

The Pines at South Mountains is located at 21st Way and Baseline Road, immediately downstream of the Highline Canal (see Figure 4-1). This location has some documented drainage issues related to flow overtopping the canal and passing through the site. Along the boundary with the canal, the development has a detention area that drains offsite flow from the Highline Canal to two large grated inlets. The inlets convey flow north to a retention basin along Baseline Road via 2-48" pipes. Flow not captured by the inlets is conveyed overland north along 21st St. and discharged into the retention basin. Documented complaints and FLO-2D results indicate that there is significant flow overtopping the canal at this location that floods 21st Ave, and potentially cross streets. The source of the offsite water can be attributed to flow in 20th St, runoff from the mountains that passes through the Siesta Foothills development and north through developed and undeveloped properties, and runoff from a smaller mountain drainage area that drains north along a drainage tract between 21st St and 21st Pl and then overland north to the Highline Canal.

Figure 4-3: Sediment in road & the Pines detention basin after recent event.

4.4.8 Area #8: Siesta Foothills Area (20th St. & Euclid Ave.)

Runoff from the mountains and possible some flow diverted northwest along Dobbins Rd from the Boy Scout Camp culvert crossing Dobbins Rd contribute to flooding issues in the vicinity of 20th St and Dobbins Rd. (see Figure 4-1). On Euclid Ave, east of 20th St, two residential properties are documented as having recurring drainage and flooding issues. The properties are located in a historic flow path but recent development upstream (Siesta Foothills) has interrupted drainage patterns and flow is now discharged to Euclid Ave. at concentrated locations east of 20th St.

The source of floodwater can be attributed to surface flows from 20th St; a bubble up outlet on Euclid Ave. which is the outlet for a culvert on the east side of 20th St.; and a 48" outlet that discharges water captured in two separate mountainside drop inlets south of Siesta Foothills (see Figure 4-4). This floodwater passes north overland through the properties along small drainages and continues north overland to the Highline Canal.

Included in potential flooding areas are properties downstream impacted by these flows and in the Siesta Foothills development where flow in excess of the capacity of the mountainside drop inlets drain into the streets and to an existing retention basin at the southeast corner of 20th Street and Euclid Avenue.

Figure 4-4: Bubble up and 48" outlet discharging to Euclid Ave.

4.4.9 Area #9: 21st Pl. & Euclid Ave.

Runoff from the mountains drains northwest to 21st St and then north across Euclid to a drainage tract between 21st Pl and 21st St. Along the west side of 21st Pl, several properties have documented drainage and flooding issues which is supported with FLO-2D results (see Figure 4-1 and Figure 4-5).

Figure 4-5: Residential flooding along 21st Pl & Euclid Ave. during recent event.

4.4.10 Area #10: 22nd St – 24th St, North of S. Mountain Ave.

West of 24th St, mountain runoff is conveyed north across Euclid Ave. through a dip crossing (see Figure 4-1). The flow is fairly well contained until the crossing of South Mountain Ave. where flow splits to the north east along a shallow wash and northwest overland. Downstream of the flow split, flows impact several large lot residential properties.

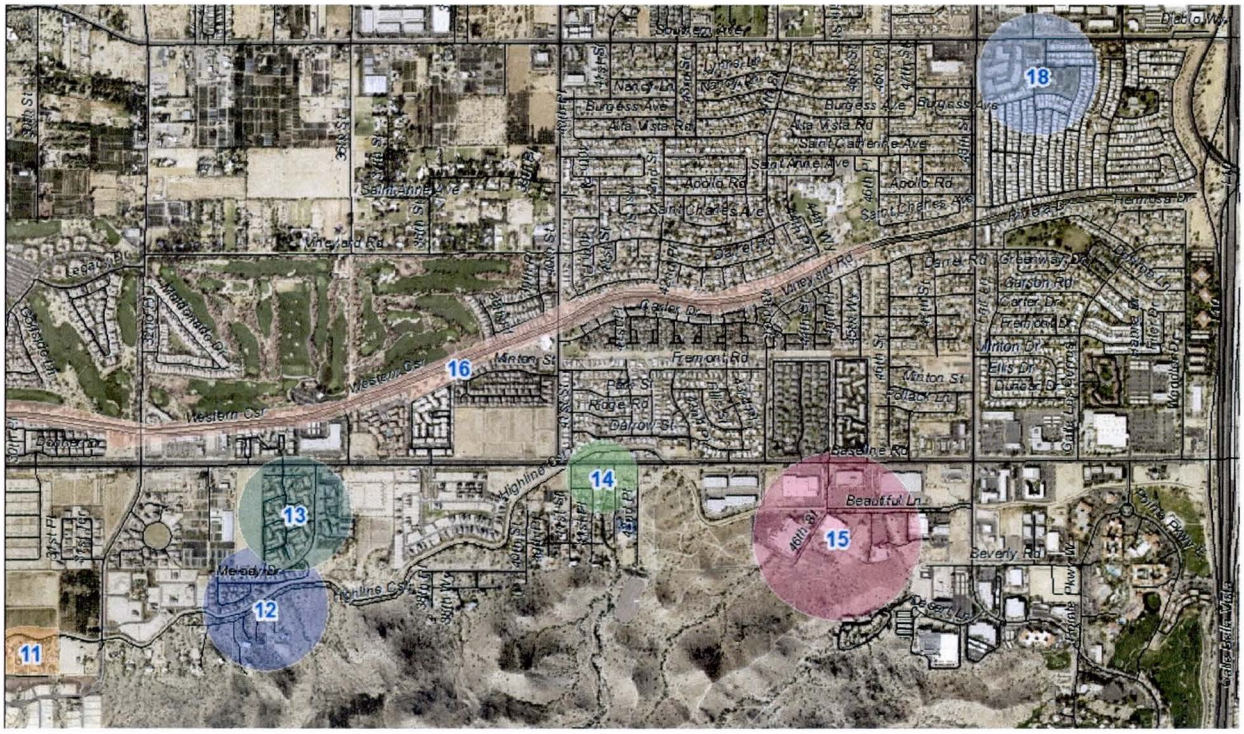


Figure 4-6: Identified Problems in the Southeast Area

4.4.11 Area #11: 25th Pl – 32nd St, Ponding along the Highline Canal

Between 25th and roughly 32nd St., there are sizeable areas and notable depths of ponding along the Highline Canal (see Figure 4-1 & Figure 4-6). Developments north of the canal have structurally sound perimeter walls that are barriers to flow and no significant accommodations are made to divert flow east or west. Impacted are properties south of the canal including an elementary school, a public park, a community center and some residential properties east of 28th St. Residential properties further south are impacted by the shallow overland flow contributing to ponding along the canal.

4.4.12 Area #12: Cortland Point (36th St & Highline Canal)

The Cortland Point subdivision is located along the north side of the Highline Canal between 34th Pl. and 36th St. (see Figure 4-6). This location has documented residential flooding. Along the Highline Canal, the adjacent residential properties are graded two to three feet lower than the Highline Canal. Runoff from the mountains overtops the canal

and either ponds behind block walls or drain directly down the canal embankment into Melody Drive. Water ponding along the block walls seeps through the blocks and in one recorded event, collapsed the wall and flooded the property and Francisco St.

Figure 4-7: Cortland Point (left) and Shadow Mountain Villas flooding (right).

4.4.13 Area #13: Shadow Mountain Villas (36th St & Baseline Rd)

Shadow Mountain Villas Condominiums is located at 36th St and Baseline (see Figure 4-6). The condo property is downstream of Cortland Point and the Highline Canal. This location has documented flooding in a parking lot located along the Highline Canal and may receive runoff from the mountains through Cortland Point via 34th Pl and/or Melody Drive and 36th St. However, the grading and drainage design of the condo development itself contributes, if not causes, the majority of the drainage and flood issues. The interior development drainage is handled by interior roads some of which have inverted crowns to increase conveyance capacity. These roads all drain to the north parking lot which also serves as the development's retention basin. Unfortunately, parked cars are susceptible to flooding several feet deep. During small rainfall events, the parking lot likely still floods to some degree. During large events, offsite drainage from flow overtopping the canal may enter the site and aggravate the situation and increase the ponding depth of the parking lot.

4.4.14 Area #14: 42nd St. & Baseline Rd.

A wash runs roughly to 42nd St and terminates at a combined culvert/storm drain hydraulic inlet south of Baseline Road (see Figure 4-6). Upstream of the wash, flow is well contained and does not appear to significantly impact adjacent residential properties during the 100-year events. However, the peak discharges for the 100 year events greatly exceed the capacity of the hydraulic inlet which outfalls to a 30" storm drain pipe and a 30" culvert. For the 100-yr, 6-hr (existing) the peak discharge is estimated at approximately 590 cfs. The consequences of the flow overwhelming the inlet is that Baseline Rd. would be flooded (2-3 ft deep) and floodwater could impact properties along the northwest corner of 40th St. and Baseline Rd.

Figure 4-8: Inlet at 40th St. & Baseline (left) & wash near Beautiful Lane (right).

4.4.15 Area #15: 46th St. & Beautiful Lane

In the proximity of 46th St and Beautiful Lane, two separate washes/drainages contribute to flooding of industrial buildings south of Beautiful Lane and potentially industrial properties north of Beautiful Land along Baseline Road (see Figure 4-6). The western-most drainage is primarily responsible for documented flooding of an industrial building. The building site was placed in the historic flow path and mountain runoff floods the parking lot and ponds behind an elevated Highline Canal which parallels Beautiful Lane. The eastern most wash has a larger drainage area and is more incised. Near Beautiful Lane, flow from the wash passes through several drop inlet and detention basins ultimately being drained by a storm drain that crosses the Highline Canal and discharges to a retention basin along Baseline Road. The magnitude of the runoff, the limited capacity of the storm drain pipes/drop inlet and blockage from debris likely contribute to the accumulation of water and potential flooding behind Highline Canal.

4.4.16 Area #16: Ponding along the Western Canal

Along the length of the Western Canal there are areas of ponding behind the canal due to the elevation of the canal embankments (see Figure 4-6 and Figure 4-9). Most likely, much of this is due to local drainage runoff but during flood events flow from Baseline Rd. and south of Baseline may contribute to flooding issues.

In addition, there are some areas downstream of the canal such as between 14th St and 16th St., where the situation is similar to Cortland Point, which could be adversely impacted from flow overtopping the canal. Water is impounded between residential block wall and the canal embankment and no accommodations are made for drainage. Failure of these walls could likely result in the flooding of downstream properties.

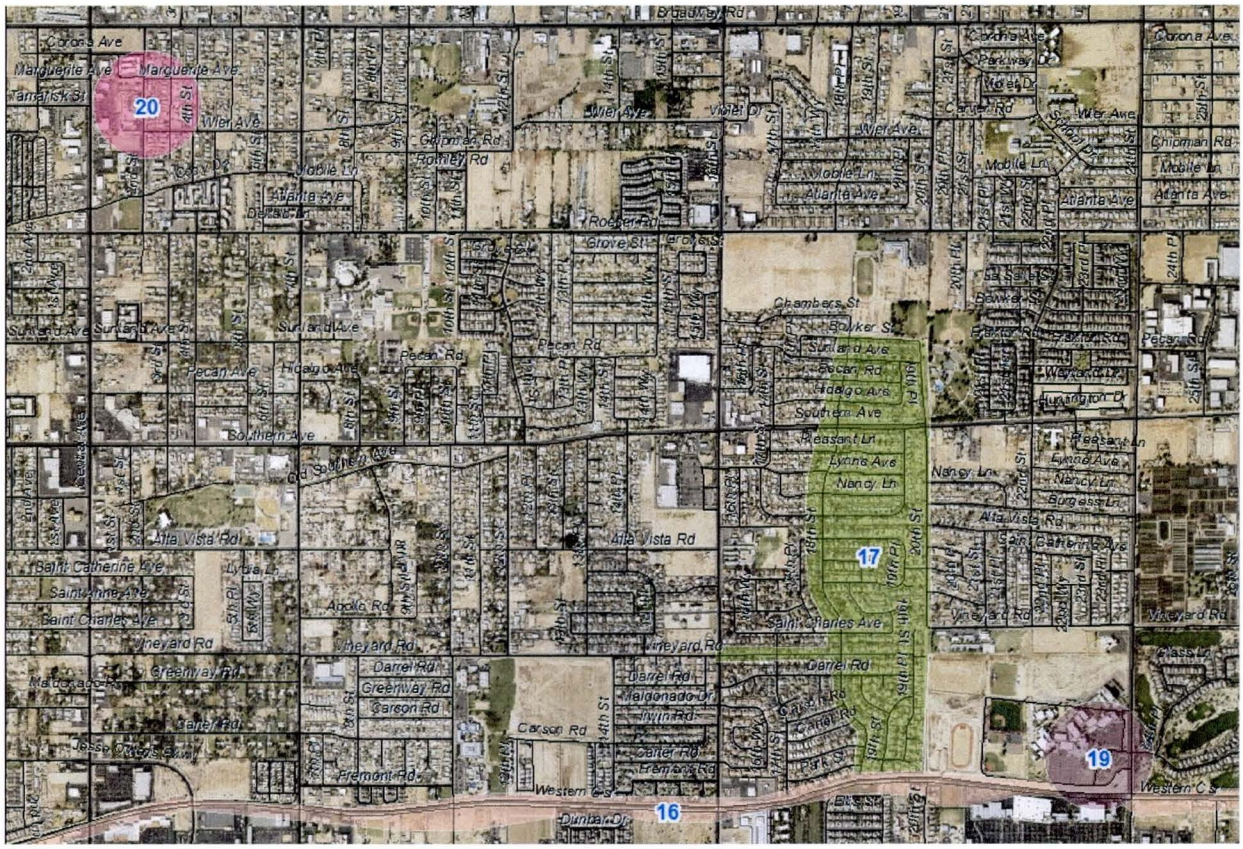


Figure 4-9: Identified Problems in the Central Area

4.4.17 Area #17: Vineyard Rd. / 18th St. / 19th Pl. / 20th St.

Drainage issues along Vineyard, west of 16th St, 18th St and 20th St have been observed in the field during field reconnaissance (see Figure 4-9). The observed issue was significant street flooding and ponding. No flooding of adjacent residential properties was observed and no formal complaints have been received by the COP. FLO-2D results do indicate the shallow flooding of several residential properties at the terminus of 19th Pl. At this location, 19th Pl. terminates in a cul-de-sac and a drainage outlet is provided to the east to 20th St. The results also reflect ponding along Vineyard Road and significant flows along 18th St (110 cfs at 18th St. south of Nancy Lane) and 20th St (200 cfs at Cross Section 70 – 20th St. & Alta Vista) south of Southern Ave. The flows contribute to flooding of Southern Ave and likely residential properties north of Southern Ave where in the general vicinity, several complaints have been documented.

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The source of the floodwater is likely primarily interior street runoff concentrating in these collector streets. However, for the 100-year events, flow overtopping the Western Canal also contributes to flows and aggravates drainage and flooding conditions. Overtopping flow is captured by hardened channels between the residential block walls and the canal embankment and discharge into the streets at cul-de-sacs terminating at the canal at 17th St., 18th St., 19th St. and 19th Pl.

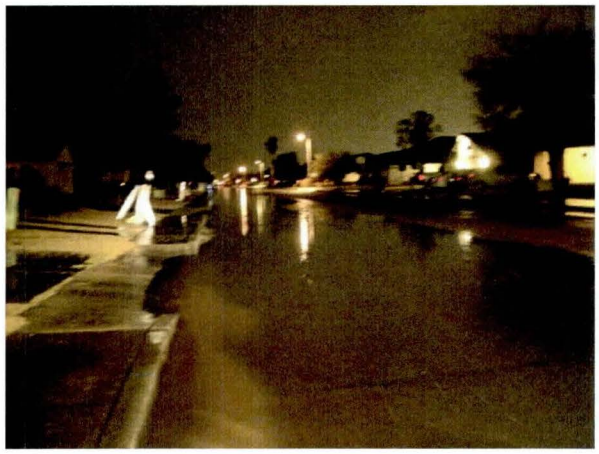
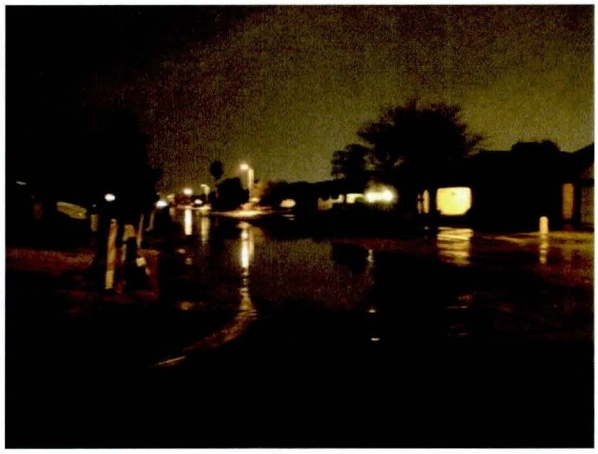

Figure 4-10: Partial closure of Vineyard Rd west of 18th St during recent storm.

4.4.18 Area #18: Contempo Tempe Mobile Home Park

This mobile home park is located east of 48th St and north of the Western Canal. FLO-2D results indicates a wide area of shallow flooding (1-1.5 ft of depth) surrounding the mobile home park's northwest retention basins just south of Southern Ave (see Figure 4-6). The source of the floodwater appears to originate with the mobile home park itself and likely due to a combination of an undersized basin and the fact that the basin has a perimeter block wall and inflow is limited to small drainage inlets.

4.4.19 Area #19: South Mountain Community College (SMCC)

Flow overtopping the canal just west of 24th St contributes to flooding primarily of the south parking lot of SMCC and retention area (see Figure 4-9).

4.4.20 Area #20: 2nd St. & Weir Ave

This appears to be a low lying area subject to periodic flooding. FLO-2D results indicate depth of 1 ft to 2.5 ft over a block of single family homes. During a site visit a resident confirmed the area had drainage and flooding issues in the past (see Figure 4-9).

4.4.21 Area #21: 19th St – Dobbins Rd to Highline Canal

Runoff from the mountains passes through the Boy Scout Camp and crosses Dobbins Rd through a large culvert (see Figure 4-1). Much of this flow is conveyed north to a 2-6'x4' RCBC through the Mountain Estates development. At the culvert some flow is diverted either northwest towards 17th Way or passes through the culvert and is discharged to a series of weirs along the west side of 19th St. All flow eventually ends up at the corner of 19th St and Euclid Ave. From north of Euclid Ave., 19th St. is an inverted crown road to convey flow. This flow contributes to flooding along Euclid Ave, 19th St and along South Mountain Ave. Residential flooding issues have been documented at 19th St. and South Mountain Ave.

5. CULTURAL RESOURCES

5.1.1 Class I Survey Summary

The preparation of the Hohokam ADMS includes a Class I survey of the cultural resources within the project area. The survey area includes a one-mile buffer around the study boundary. Below is a brief summary of the results of the Class I survey. The complete survey, *A Class I Cultural Resources Inventory Survey of 16, 000 Acres for the Hohokam Area Drainage Master Plan, Phoenix, Maricopa County, Arizona. October 2010 (LSD)* is provided separately.

The survey included literature and records review of archaeological site files, inventory reports and data at; the Arizona State Historic Preservation Office (SHPO); the Arizona State Museum (ASM) using AZSITE; site files at the Pueblo Grande Museum (PGM); the City of Phoenix and City of Tempe Historic Preservation Departments to determine boundaries of City-listed historic districts and the National Register Information System to gather information about National Register of Historic Places (NRHP)-listed properties in the study area. Historic General Land Office (GLO) maps were also reviewed and road features and canals are depicted on those maps.

The records search indicated that more than 200 surveys have been completed within the study area. Collectively, these surveys encompass 616 acres, or approximately 4 percent of the study area. The archaeological surveys identified 112 prehistoric and historic cultural resources. The prehistoric sites span the length of the Hohokam occupation in the Phoenix Basin; site types range from artifact scatters and petroglyph sites, to agricultural sites associated with canals and field houses, to large village sites with cemeteries. The historic period sites include canals (Roosevelt Canal, Western Canal, San Francisco, Hayden, and North Branch Highline), multiple spurs of the Southern Pacific Railroad (Welton-Phoenix-Eloy and Tempe-West Chandler), and cemeteries, as well as artifact/trash scatters with and without features, and buildings.

The majority of previously recorded cultural resources within the Hohokam study area have not been evaluated for their NRHP eligibility. Three historic properties are listed in the NRHP including the Niels Peterson House, the Phoenix Carnegie Library and Park, and the Ralph H. Stoughton Estate. Eight other cultural resources and five sites have been previously determined eligible for inclusion in the NRHP. For the remainder of the identified cultural resources, 4 were recommended for testing to determine NRHP-eligibility, 45 were recommended NRHP-eligible, and 60 are unevaluated or of unknown eligibility.

If existing or newly recorded NRHP-eligible cultural resources could be affected by drainage improvements, these resources shall be treated in a manner consistent with the Secretary of the Interior's Guidelines for the Treatment of Historic Properties, applicable Arizona statutes, and City of Tempe and City of Phoenix regulations.

6. CSFHM INVENTORY & ANALYSIS

6.1 INTRODUCTION

The District's Context Sensitive Flood Hazard Mitigation (CSFHM) Planning and Design Approach was implemented as a part of the Hohokam ADMS. The CSFHM Approach is designed to serve as a framework and tool for the development of flood hazard mitigation plan alternatives that integrate the three basic required functions of being **A**cceptable to local communities, **C**ompatible with landscape resources and **E**ffective in reducing flood losses (**ACE**). A context sensitive solution is one that is capable of performing all three of these basic functions.

The CSFHM model examines the interrelationship between three contexts: Community, Land & Resources and Flooding (see Figure 6-1). The Community Context was defined in this study based upon an inventory and analysis of the direction and vision contained in local community plans including:

- Phoenix General Plan 2002
- City of Tempe General Plan (2030)
- Baseline Area Master Plan (1996)
- Target Area B Redevelopment Plan (1998)
- Rio Salado Beyond the banks Area Plan (2003)
- Rio Montana Area Plan (2000)
- South Central Avenue Corridor Study (1993)

The Land & Resources Context was defined, by the District, through an inventory and assessment of the valued characteristics of landscape resources that included scenery, recreation and open spaces. The Flooding Context was defined through an inventory of flooding types and an assessment of public exposure to flooding.

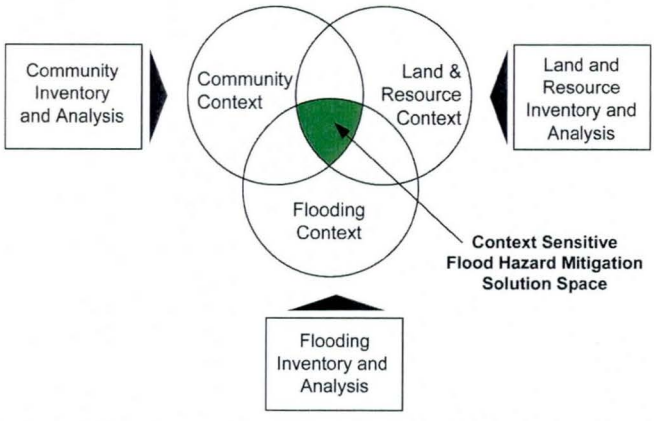

Figure 6-1: Context Sensitive Flood Hazard Mitigation Planning & Design Model

Application of the CSFHM Approach involves use of the six step process outlined below:

1. Project Goals & Objectives Establishment
2. Range of Possible Flood Hazard Mitigation Solutions Identification
3. Context Inventories
4. Context Analyses
   a. Predictive Analysis
   b. Comparative Analysis
5. Alternatives Formulation and Analysis
6. Recommended Plan Selection and Refinement

The District identified a range of flood hazard mitigation solutions, including various Structure Types, Structural Methods and Landscape Design Themes that are often considered for the development of flood hazard mitigation plan alternatives (see Table 6-1). A fully context sensitive solution requires the identification and use of a combination of Structure Types, Structural Methods and Landscape Design Themes that are all capable of performing the three functions of being Acceptable, Compatible and Effective (ACE). Detailed descriptions of the Structure Types, Structural Methods and Landscape Design Themes can be found in the District's Flood Protection Structure Types, Methods and Landscape Design Themes Handbooks available on the District's website.

Table 6-1: Aspects of Flood Hazard Mitigation Solutions

Structure Types	Structural Methods	Landscape Themes
• Natural Structure • Underground Pipe • Channel Levee • Conveyance Channel • Storage Basin • Dam	• Natural • Soft Structural • Semi-Soft Structural • Enhanced Hard Structural • Semi-Hard Structural • Hard Structural	• Natural Sonoran Desert Upland • Natural Sonoran Desert Upland Riparian • Natural Lower Sonoran Desert • Natural Lower Sonoran Desert Riparian • Natural Sonoran Desert Hydro Riparian • Semi-Natural Sonoran Desert • Enhanced Desert • Desert Park • Desert Oasis • Urban Plaza

Information contained in the inventories of the three contexts was then used in a Predictive Analysis to assign acceptability, compatibility and effectiveness ratings to each Structure Type, Structural Method and Landscape Design theme. These ratings and the inventory maps were then utilized in GIS to produce maps that revealed the range of acceptable, compatible and effective Structure Types, Structural Methods and

Landscape Design Themes for discrete geographic areas within the study area. Finally, a Comparative Analysis was undertaken to combine and synthesize the results of the Predictive Analysis maps for each context. This step revealed the range of Structure Types, Structural Methods and Landscape Design Themes that are capable of simultaneously performing all three functions (ACE) of a context sensitive solution for discrete geographic areas within the study area.

The range of context sensitive solutions that were revealed from implementation of the Predictive and Comparative Analysis steps of the CSFHM Approach are intended to serve as the building blocks for development of context sensitive plan alternatives during the alternatives formulation stages of the study. The CSFHM analysis of the three contexts is also serves as a baseline for evaluating the context sensitivity of the Alternatives during the alternatives evaluation stage of the study.

The following sections briefly describe the inventory and analysis of the Community, Land & Resource and Flooding Contexts for the Hohokam ADMS. A more detailed description of the CSFHM process is provided in the Hohokam ADMS Data Collection Report.

6.2 COMMUNITY CONTEXT

This section contains an overview of the inventory and analysis of the Community Context. The inventory of the Community context included collection and review of community plans containing direction relating to the acceptability of various flood hazard mitigation solutions that might be considered in the development of plan alternatives for the Hohokam ADMP. The primary sources of information that were utilized in assessment of the Community Context included: 1) the Phoenix General Plan, 2) The General Plan Recreation and Open Space Elements, and 3) Specific Area Plans, including the Baseline Area Master Plan, Target Area B Redevelopment Plan, Rio Solado Beyond the Banks Plan, Rio Montana Area Plan and the South Central Avenue Corridor Study. A summary of the inventory of these plans along with the Community Context Acceptability Class maps for the Structure Types, Structural Methods and Landscape Design Themes that were produced for each of the above inventoried community plans may be found in the Hohokam ADMS Data Collection Report.

6.2.1 Results of Community Context Analysis

To determine the range of acceptable FHM solutions, the planning team participated in a workshop to review the available character and aesthetic elements of the plans and identify the acceptability of the Structural Methods, Structure Types, and Landscape Themes within each specific study area. Using GIS, the District compiled the workshop information into datasets that combined the acceptability of each component for all the study areas and each component.

6.2.1.1 Structure Type Acceptability

All structure types except for a dam were determined to be acceptable throughout most of the study area (see Figure 6-2). In open space and park areas, all other methods would be acceptable with the exception of a channel levee and a dam. All structural methods would be acceptable in areas comprised of heavy commercial and industrial land uses which may be found in the eastern portion of the study area.

6.2.1.2 Structural Methods Acceptability

Throughout the study area, the natural method, soft structural, and semi-soft structural were generally determined to be acceptable (see Figure 6-3). Hard structural methods would be acceptable only in limited areas.

6.2.1.3 Landscape Themes Acceptability

Throughout most of the study area, all landscape themes would be acceptable except Natural Sonoran Desert Hydro Riparian and the Urban Plaza (see Figure 6-4). In the South Mountain area, the acceptable themes are limited to the Natural Sonoran Desert themes while generally most themes except the Natural Sonoran Desert Upland and Natural Sonoran Desert Upland Riparian themes would be acceptable.

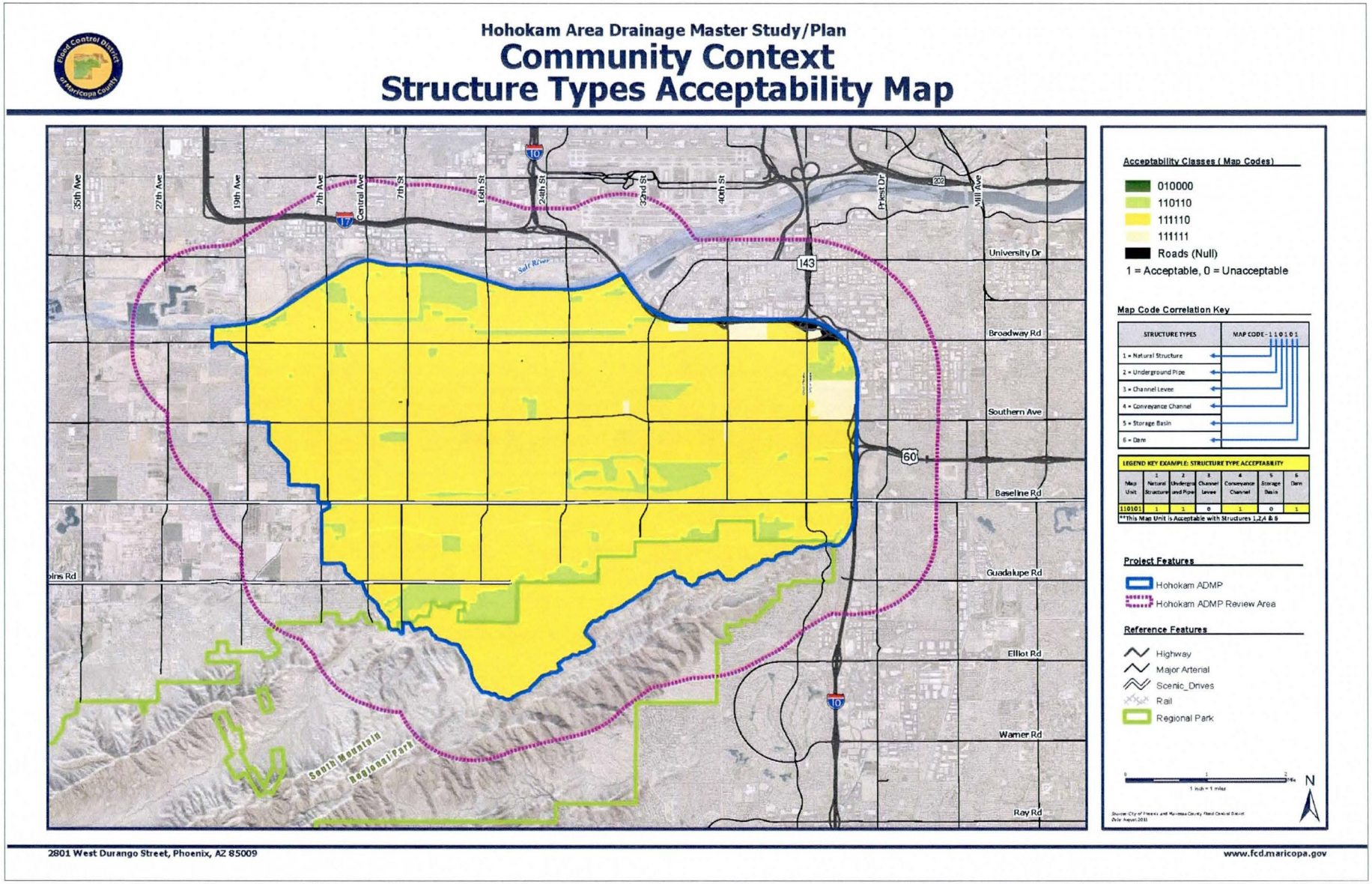

Figure 6-2: Structure Types Acceptability

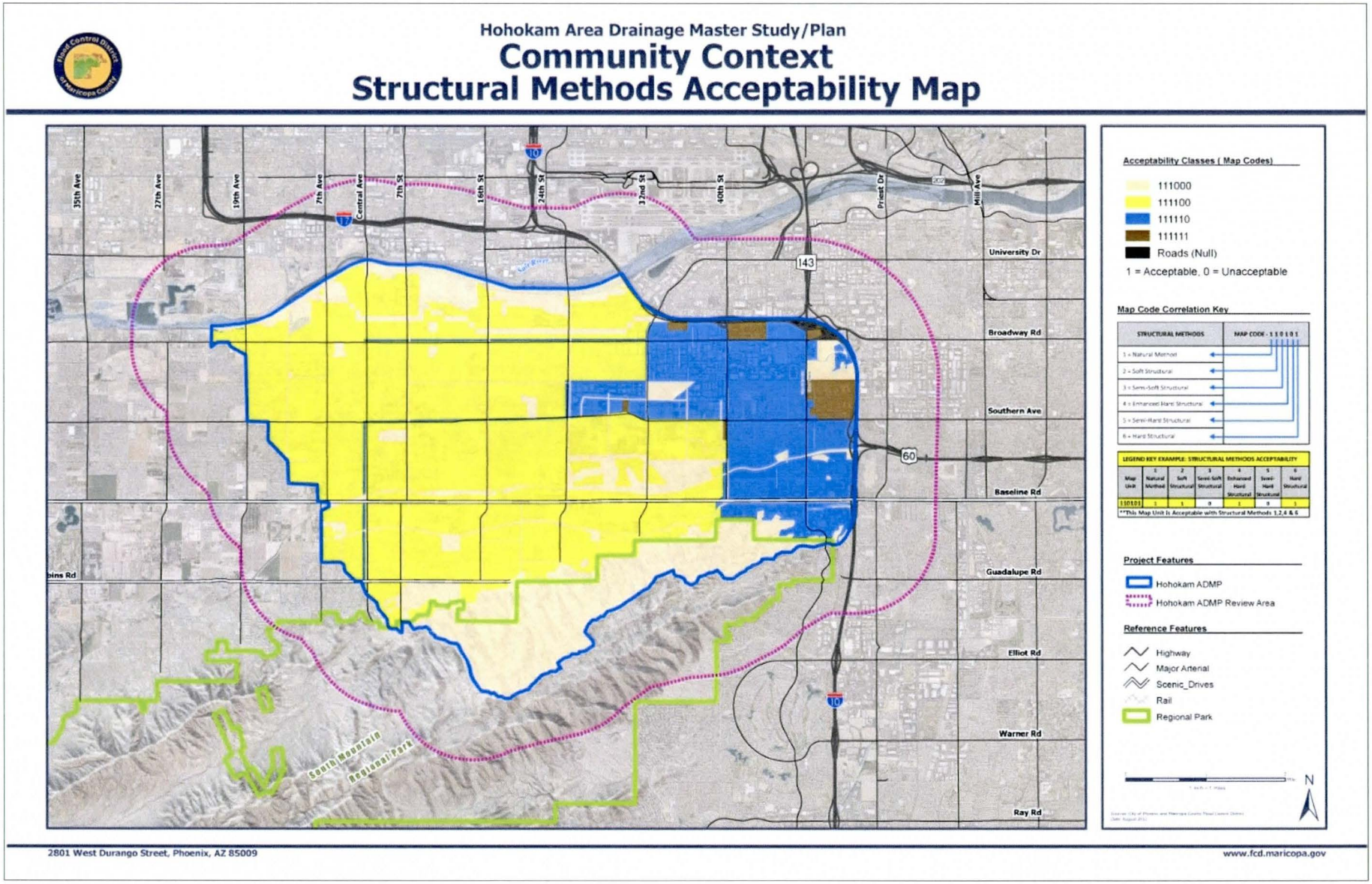

Figure 6-3: Structural Methods Acceptability

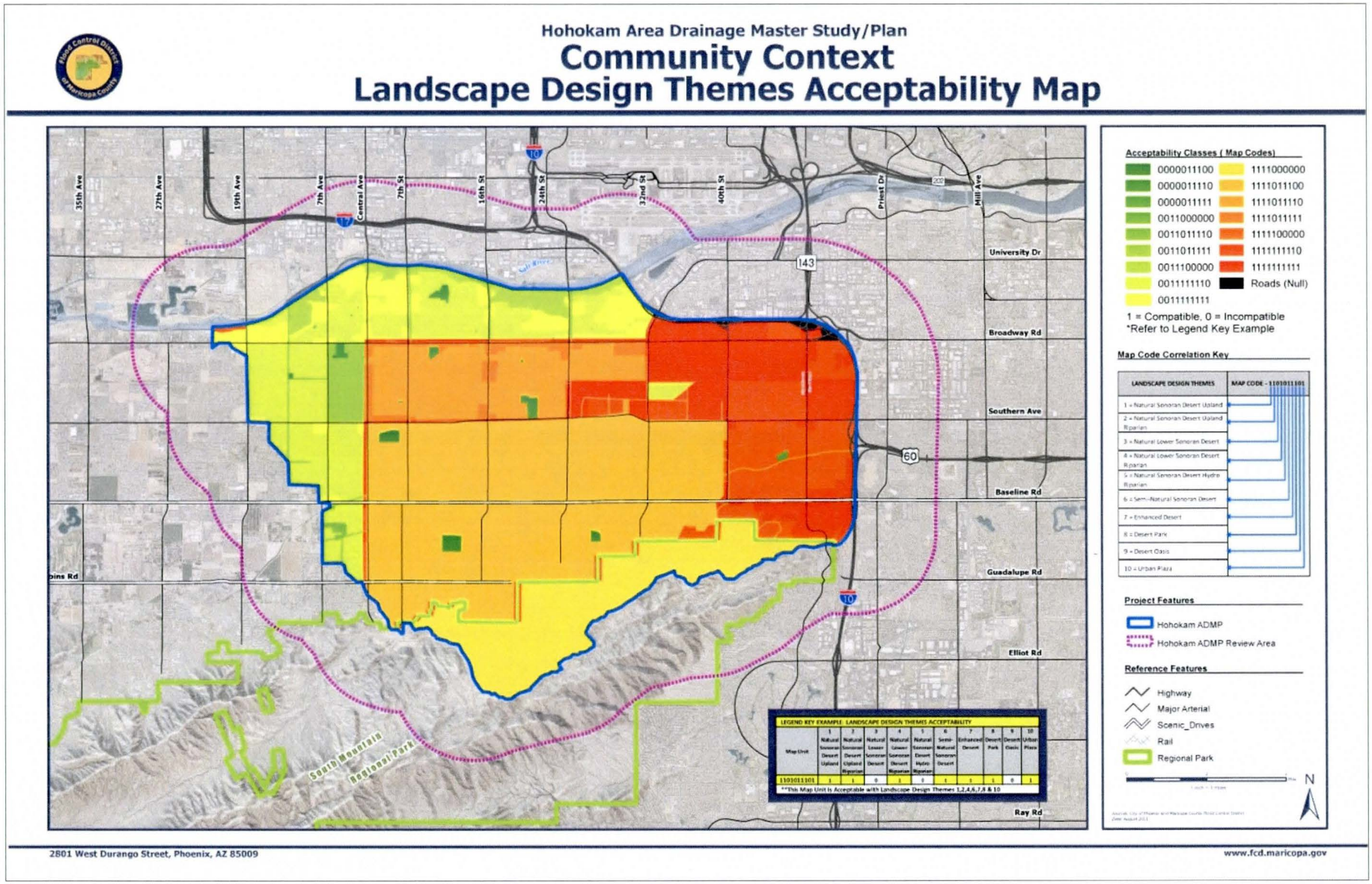

Figure 6-4: Landscape Design Theme Acceptability

6.3 LAND AND RESOURCE CONTEXT

This section provides an overview of the inventory and analysis of the Land and Resource Context. A project level inventory and analysis (Project LIA) was provided by the District that was derived from its county-wide Landscape Inventory and Analysis (County-wide LIA). This assessment included inventories of scenery, recreation and open space resources. It also included assessments of the compatibility of a range of flood hazard mitigation structure types, structural methods and landscape design themes with these inventoried resources. For more detailed information about the Project LIA for the Hohokam ADMS, please refer to the Hohokam ADMS Data Collection Report.

The following is a summary of the compatibility of possible structural methods, structure types, and landscape design themes with the combined landscape resources (scenery, recreation and open space) of the study area. The compatibility of structure types, structural methods and landscape themes in the land and resource context are shown in the LIA provided in the Hohokam ADMS Data Collection Report.

6.3.1.1 Structure Types Compatibility

Natural structures are the only flood hazard mitigation structure types that are compatible within the floodway and flood fringe of the Salt River as well as the slopes of South Mountain (Figure 6-5). All structure types would be compatible over the majority of the study area, and in a few areas, all of the structure types, except for dam structures are compatible with the land and resource context.

6.3.1.2 Structural Methods Compatibility

Natural is the only structural method that is compatible within the floodways, flood fringe areas and the slopes of South Mountain (Figure 6-6). The Semi-Soft Structural, Soft Structural and Natural Methods are compatible for a majority of the study area. Hard Structural Method is compatible in areas of heavy commercial or industrial use which are mostly located in the northern and eastern portions of the study area. All of the structural methods are compatible within the industrial valley plain landscape units.

6.3.1.3 Landscape Design Theme Compatibility

The Natural Sonoran Desert Uplands and Riparian landscape design themes would be compatible within the South Mountain area (Figure 6-7), while Natural Lower Sonoran Desert Riparian and Hydro-riparian landscape design themes would be compatible in areas along the Salt River. Within the developed areas throughout most of the study area, landscape design themes including the Semi-natural Desert, Enhanced Desert, Desert Park, Oasis and plaza themes would be compatible.

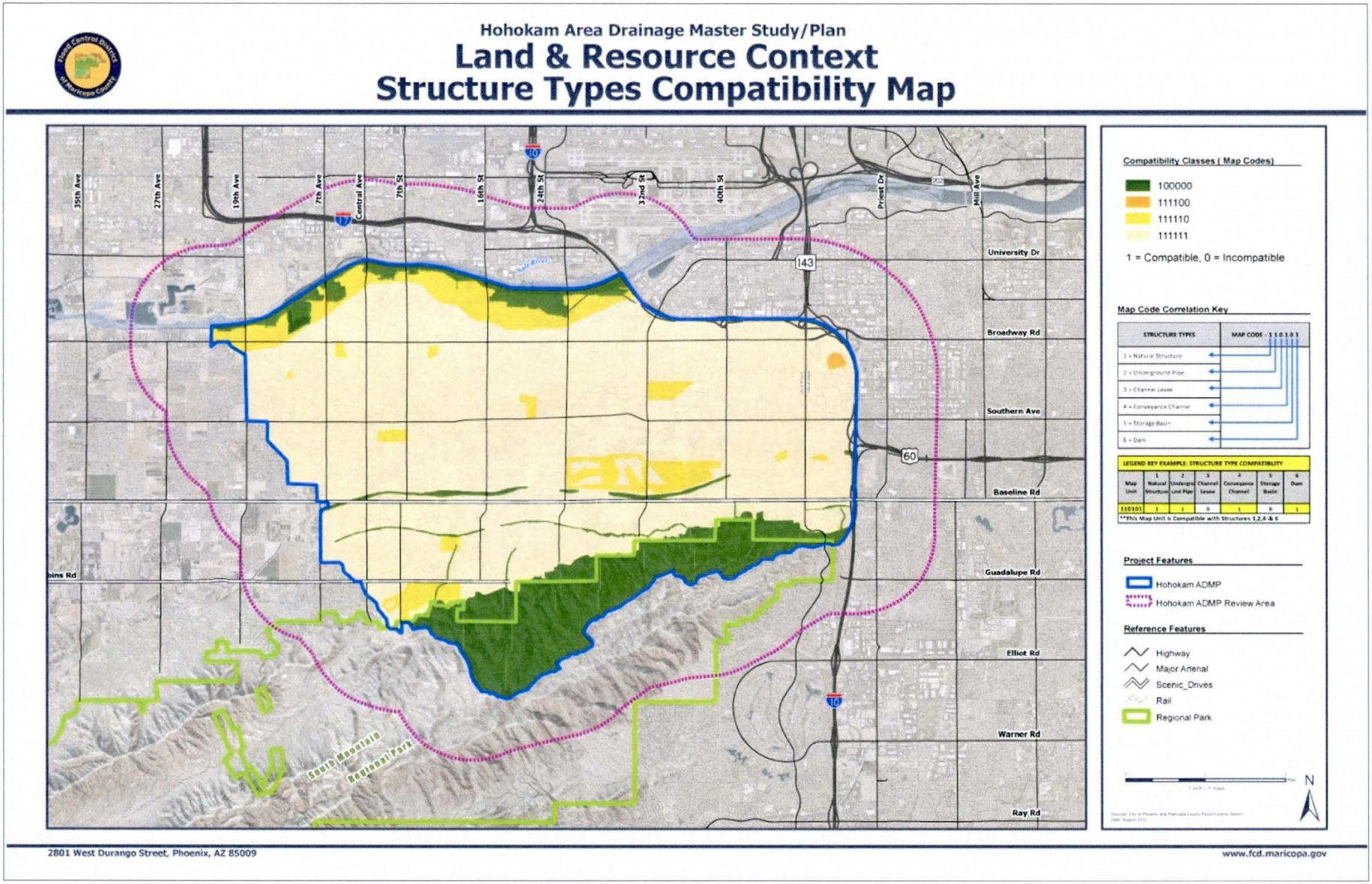

Figure 6-5: Future Combined Structure Types Compatibility

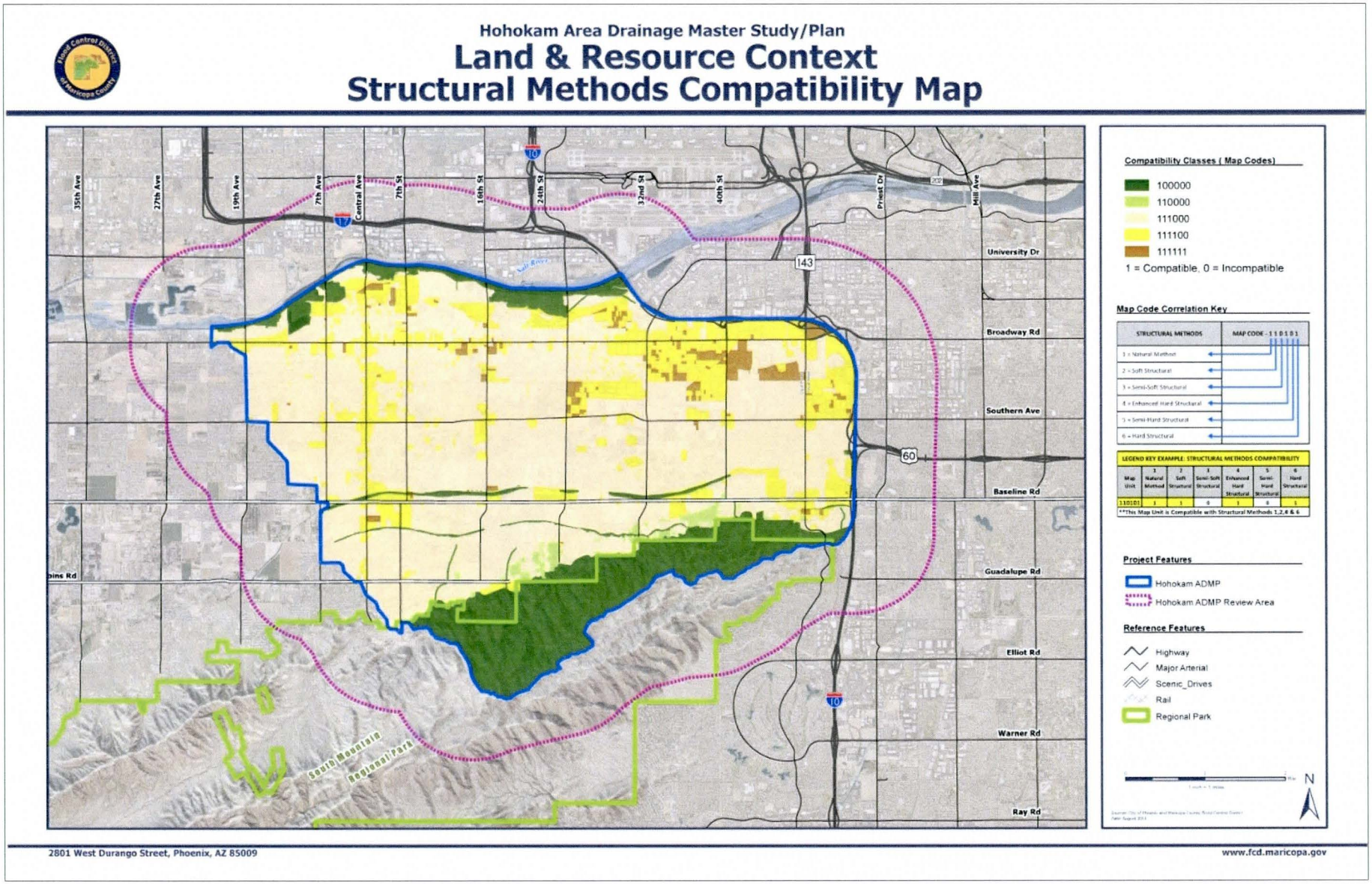

Figure 6-6: Future Combined Structural Methods Compatibility

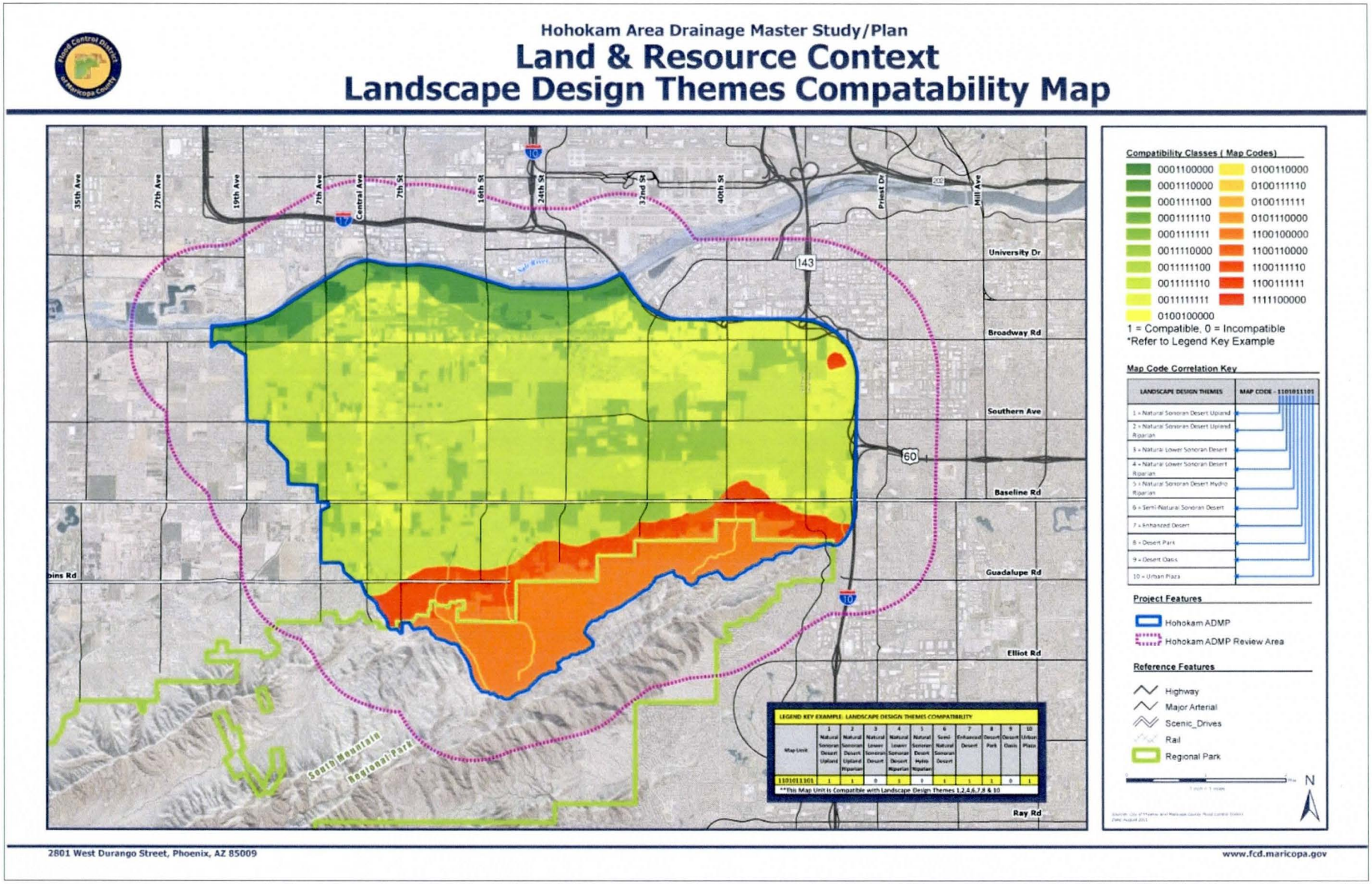

Figure 6-7: Future Combined Landscape Theme Compatibility

6.4 FLOODING CONTEXT

This section contains an overview of the inventory and analysis of the Flooding Context. The inventory of the Flooding Context included an identification and evaluation of the flooding types and the flood hazards that are associated with them. The inventory also included an assessment of flood risks based upon the proximity of humans to the identified flood hazards. The flooding type over most of the study area is overland sheet flow with the notable exception of riverine wash flows that occur within the incised channels located within the mountain slopes of South Mountain.

To identify the effective approaches to mitigate flooding hazards, the study team participated in an evaluation workshop to determine the Structural Methods, Structure Types, and Landscape Themes for those elements that would be effective for each type of flooding hazard.

6.4.1.1 Effective Flood Control - Structure Types

Similar to the flood control methods, all structure types except a natural structure would be considered effective over the majority of the area (see Figure 6-8). In the areas of riverine flow, underground pipe, channel levee and conveyance channels would be considered the most effective flood control structure types. In the South Mountain area, all structure types would be effective.

6.4.1.2 Effective Flood Control - Structural Methods

The simplicity of the drainage patterns and flooding types leads to a simple solution for developing effective flood control methods (see Figure 6-9). Except within the South Mountain Park, all flood control methods except a natural method could be effective. Within South Mountain Park all methods would be considered effective.

6.4.1.3 Effective Flood Control - Landscape Themes

For landscape themes, only the limited riverine flow areas would have some limitations on themes for the flooding context (see Figure 6-10). In those areas the Natural Sonoran Desert Upland and Upland Riparian Themes as well as the Desert Oasis and Urban Plaza themes would not be considered effective. Throughout most of the study area, all themes except the two natural Sonoran Desert themes would be considered effective for the flooding context. In the South Mountain Area, all landscape themes would be effective.

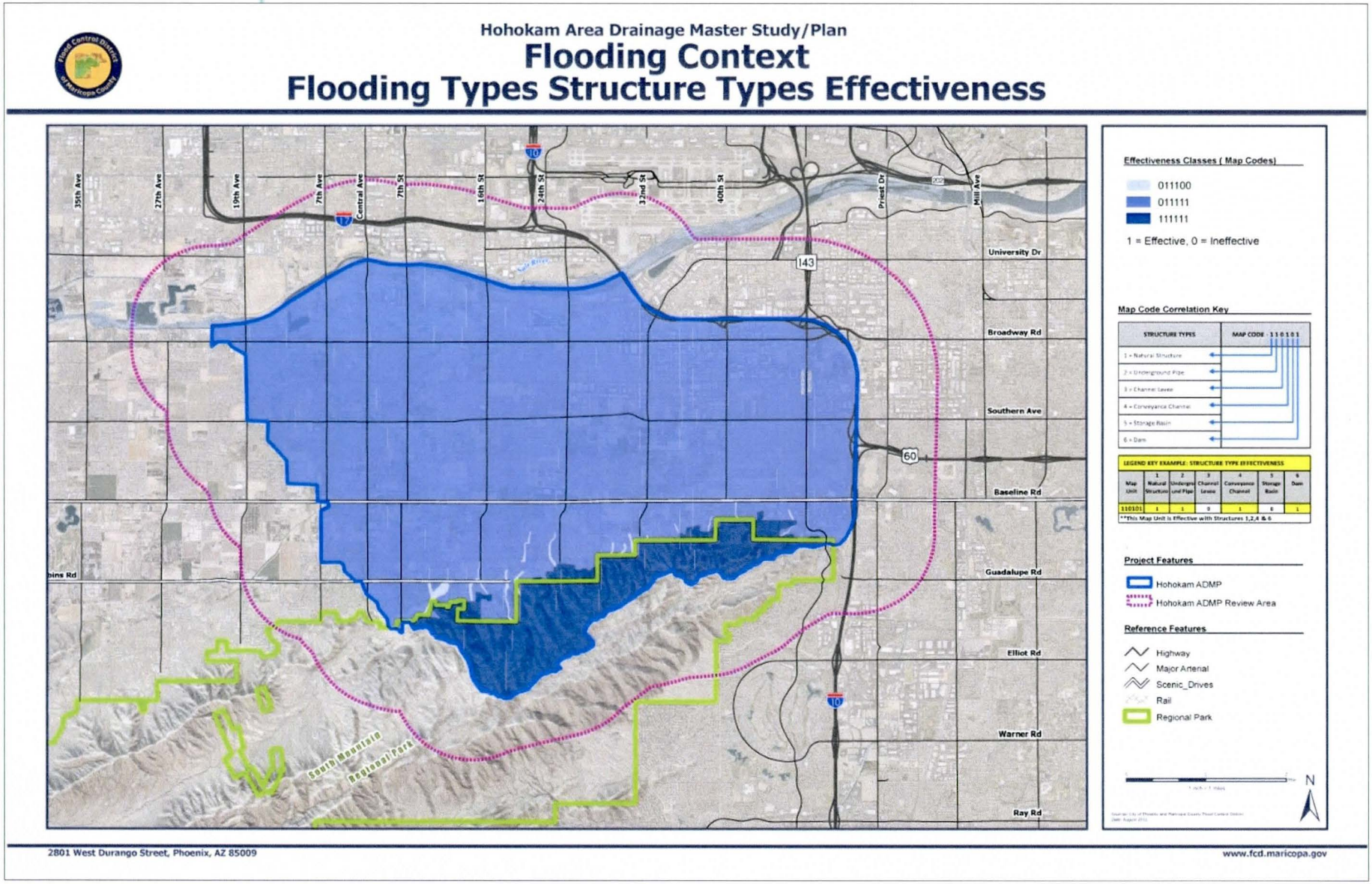

Figure 6-8: Flooding Context Structure Types Effectiveness

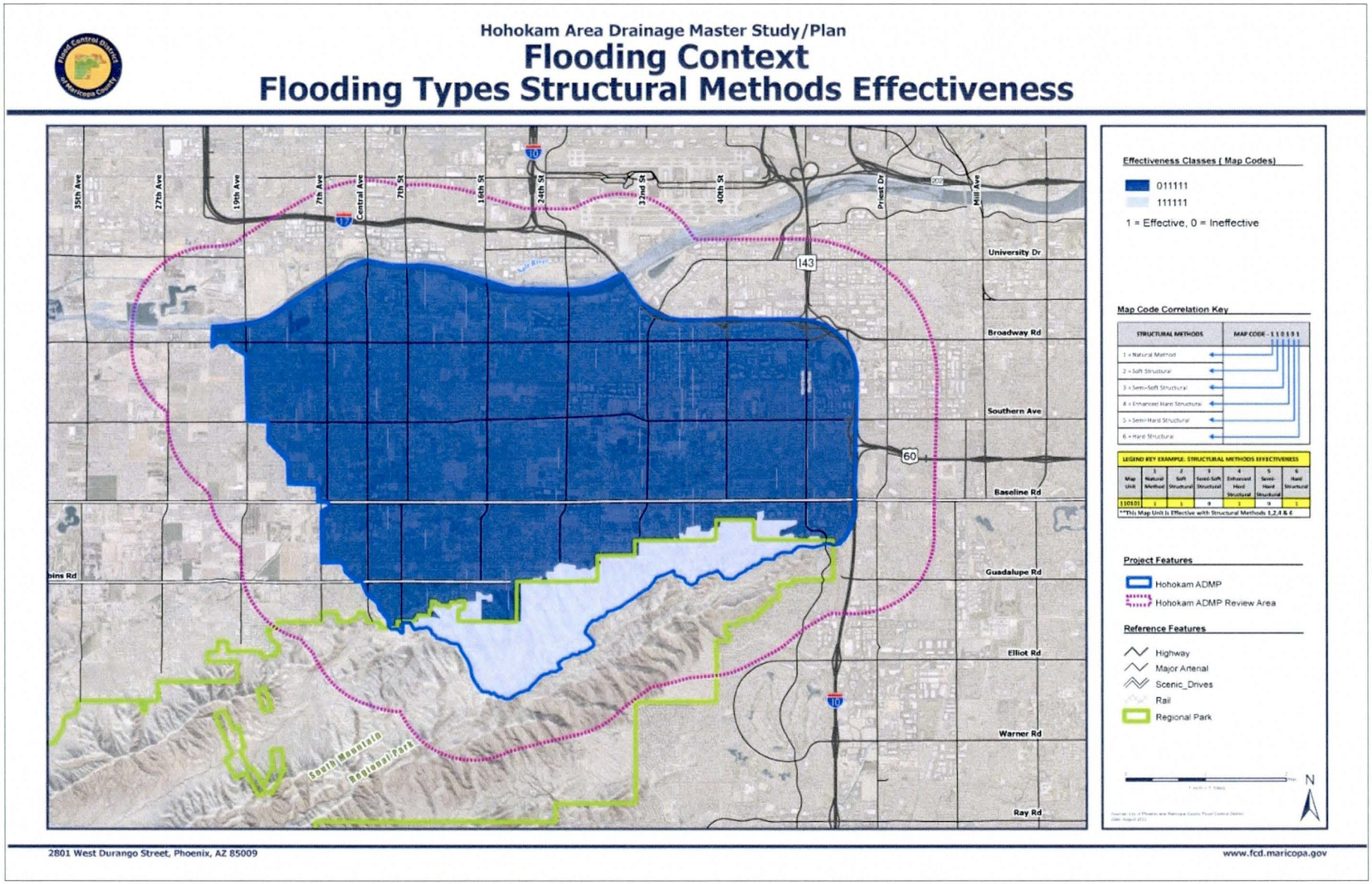

Figure 6-9: Flooding Context Structural Methods Effectiveness

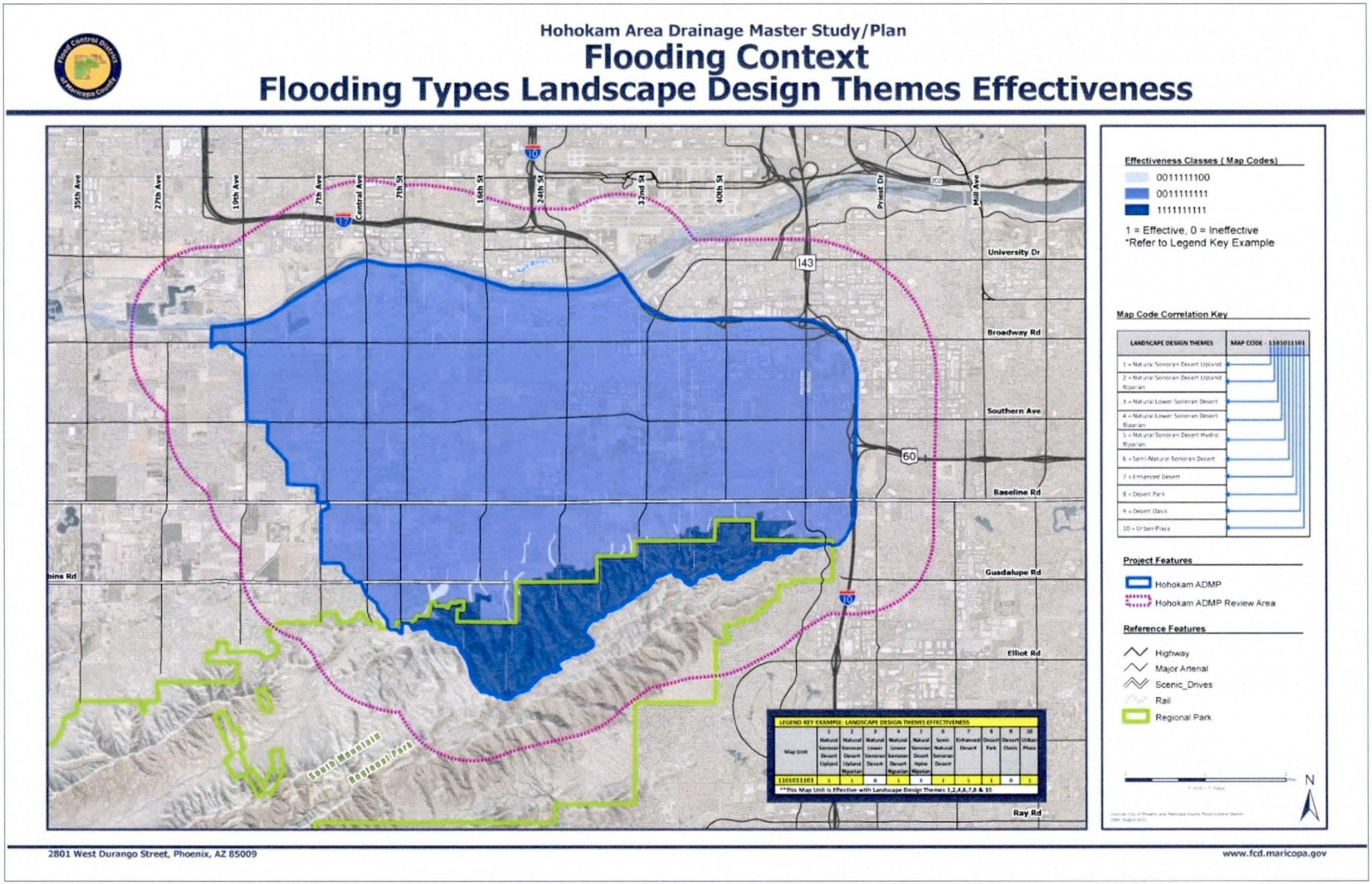

Figure 6-10: Flooding Context Landscape Design Themes Effectiveness

6.5 CSFHM ANALYSIS AND RESULTS

In the final step of the analysis, information from the analysis maps for the three contexts is combined using GIS to identify those FHM solutions that concurrently meet all three of the basic functional requirements of being acceptable, compatible and effective (ACE) for a CSFHM solution. The comparative analysis begins with a comparison of the range of effective solutions with the range of compatible solutions to identify the set of solutions that is both effective and compatible (see Figure 6-11). The effective/compatible set of solutions are then compared with the range of acceptable solutions to identify the set of solutions that meet the ACE criterion.

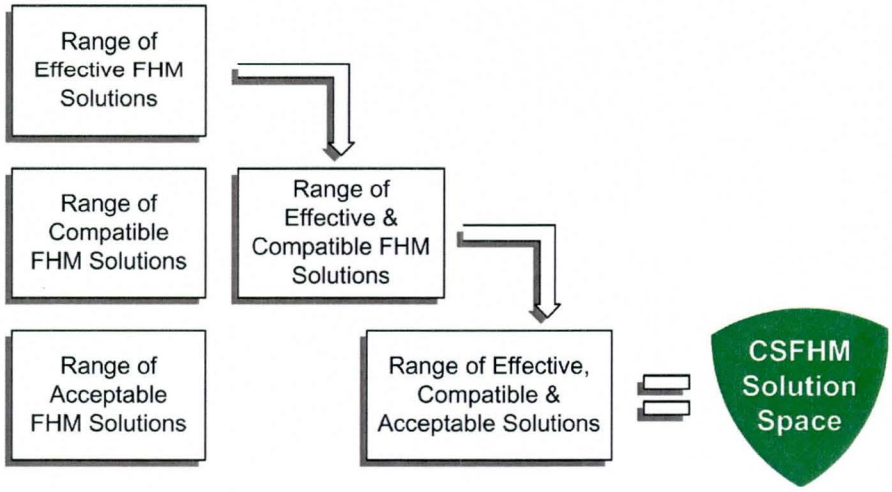

Figure 6-11: Comparative Analysis Process

6.5.1.1 Context Sensitive Structure Types

For most of the study area, underground pipe, channel levee, conveyance channel or storage basin could be part of a context sensitive flood control solution (see Figure 6-13). In most open space areas, all structure types except for the natural channel and channel levee would be context sensitive. In the South Mountain area, only the natural structure would be context sensitive. In limited locations in the northeast portion of the study area all methods except the natural structure would be context sensitive.

6.5.1.2 Context Sensitive Structural Methods

For most of the study area, Natural, Soft Structural and Semi-Soft Structural methods would be part of a context sensitive solution (see Figure 6-12). In the north and eastern parts of the study area and along some of the arterial roads, enhanced Hard Structural methods might also be considered context sensitive.

6.5.1.3 Context Sensitive Landscape Design Themes

The large number of landscape design themes creates a somewhat complex array of landscape themes that would be a context sensitive part of a flood control solution. However, there is generally a good selection of landscape themes that would be considered context sensitive in most areas so that the landscape design would have the flexibility to meet a variety of site specific landscape conditions. In general the Natural Sonoran Desert Upland and Upland Riparian themes would be context sensitive in the South Mountain area (see Figure 6-14). Semi Natural Sonoran Desert, Enhanced Desert and Desert Oasis would be context sensitive in the bajada areas at the base of the mountain. For most of the study area, the Natural Lower Sonoran Desert themes, the Semi-natural Sonoran Desert, enhanced Desert and Desert Park would be context sensitive.

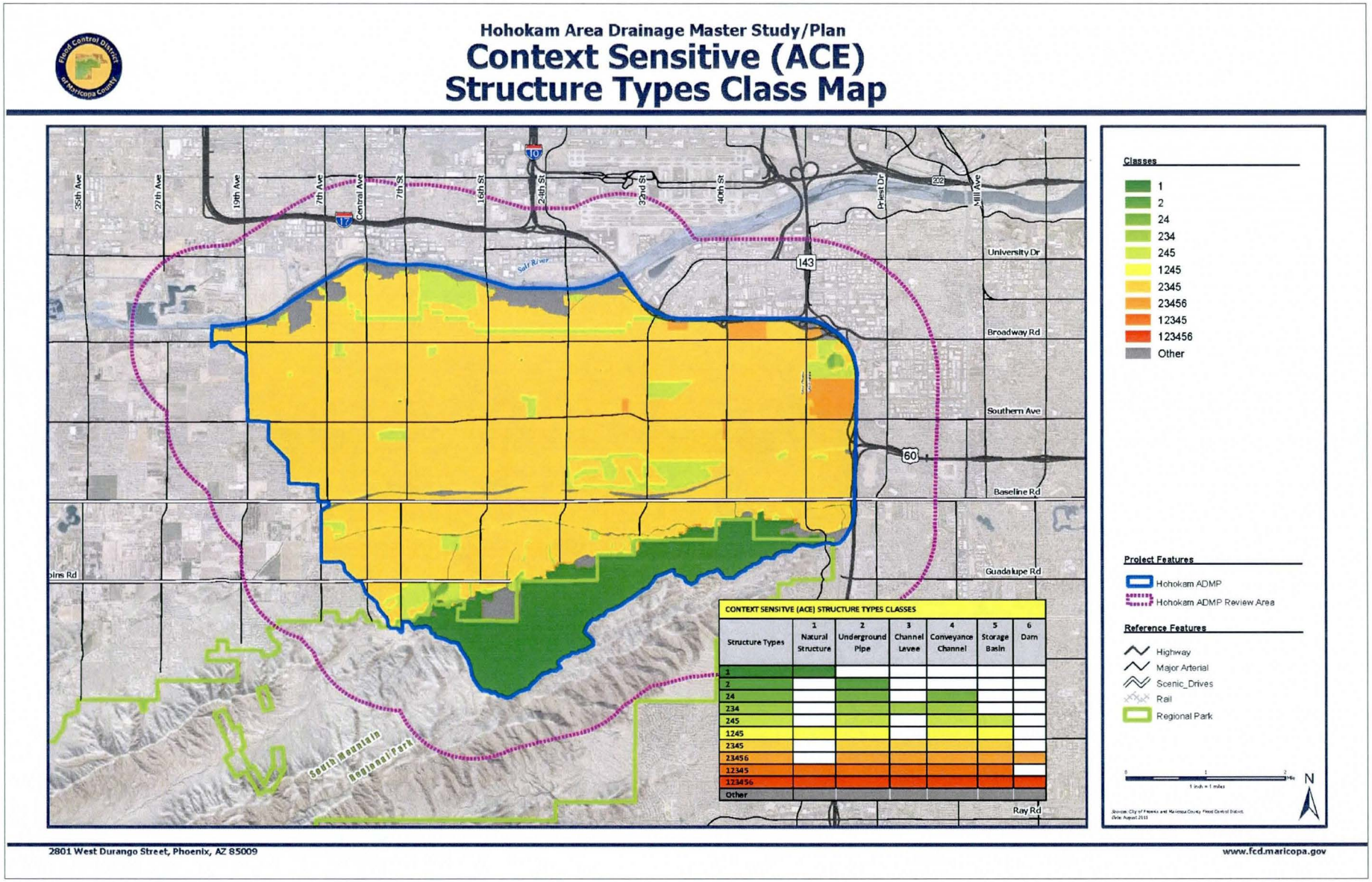

Figure 6-12: Structure Types Context Sensitive Classes

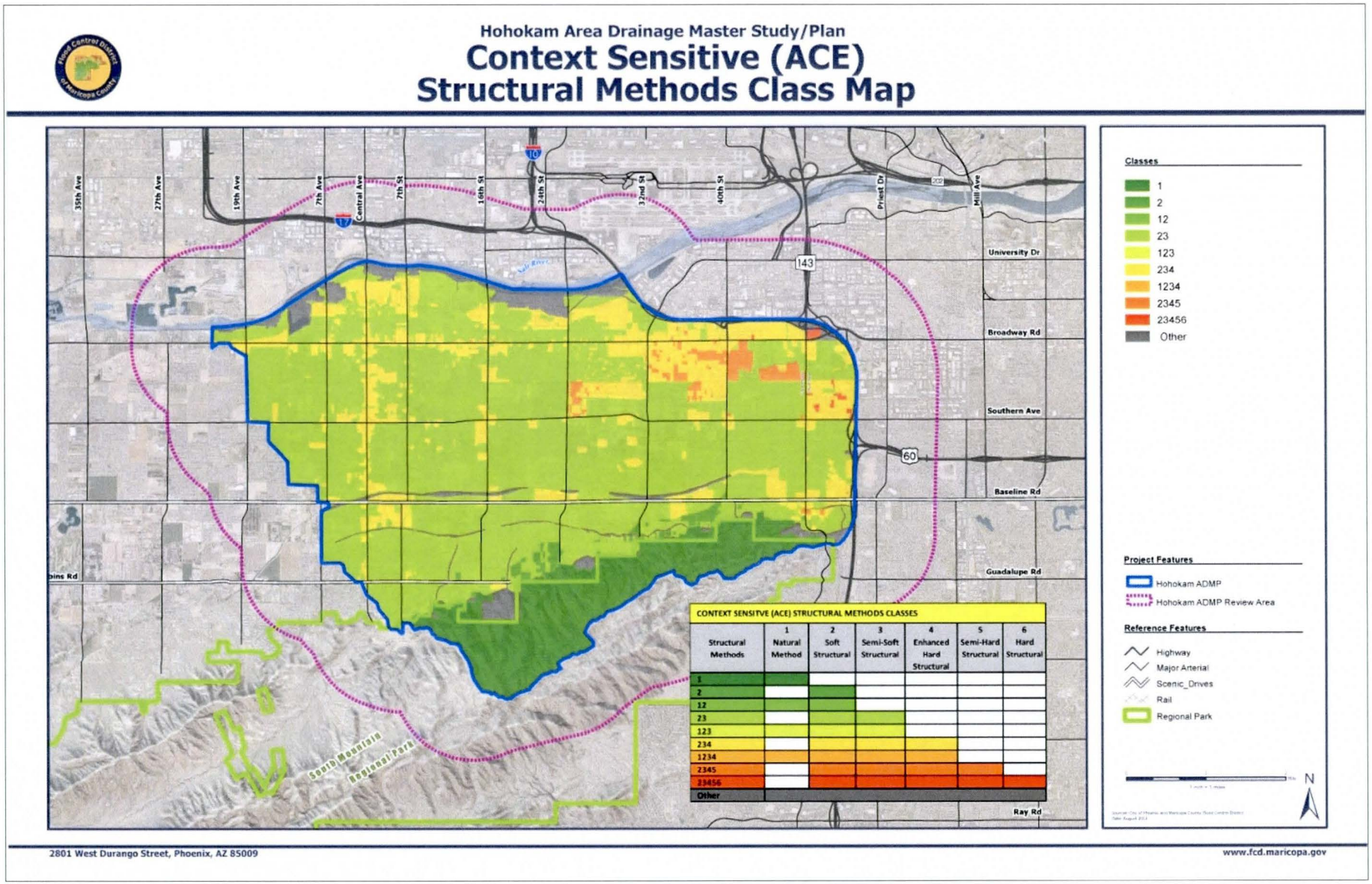

Figure 6-13: Structural Methods Context Sensitive Classes

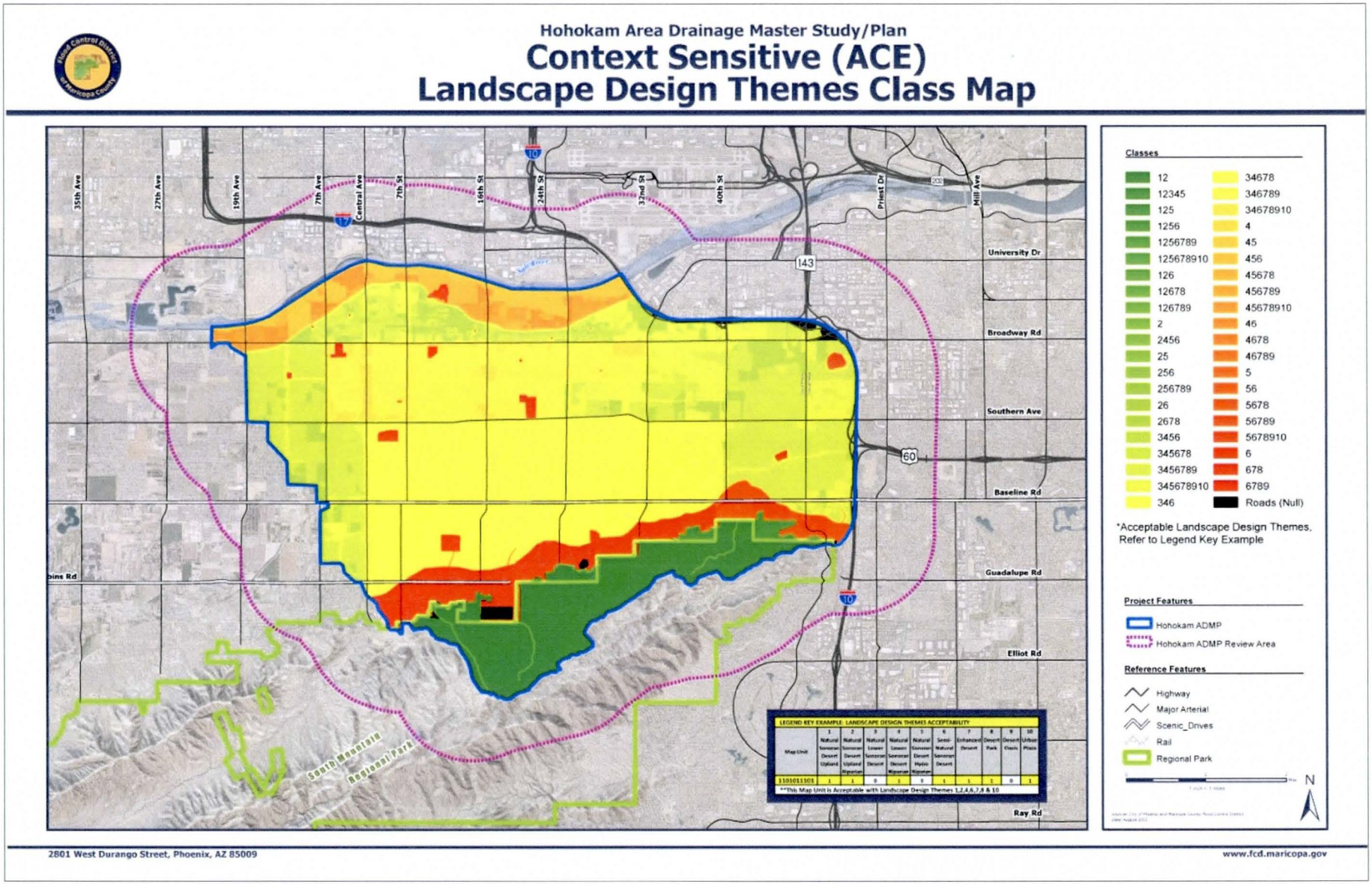

Figure 6-14: Landscape Design Themes Context Sensitive Classes

7. BRAINSTORMING SESSION

7.1 GENERAL

Project team members, additional District personnel, and project stakeholders were invited and participated in the Phase I Brainstorming session. For purposes of the brainstorming session, eight areas were defined based upon the identified flood hazards areas and the potential source of the flooding issues. The areas are only generally defined and often overlap with adjacent areas since flooding issues are often interrelated (see Figure 7-1). At the session, the results of the data collection effort were provided including the general plans, cultural and land resources, study area opportunities and constraints and the results of the Landscape Inventory Analysis performed by the District. The results of the FLO-2D analyses were also presented including a FLO-2D animation to help define the problem areas and show potential flooding sources and contributing drainage areas. Participants were then divided into six working groups with each group assigned a brainstorming area with the exception of one group (Group 6) that was assigned three (Areas 6A, 6B and 6C). The groups then brainstormed ideas to address the flooding issues and presented them to the entire project team.

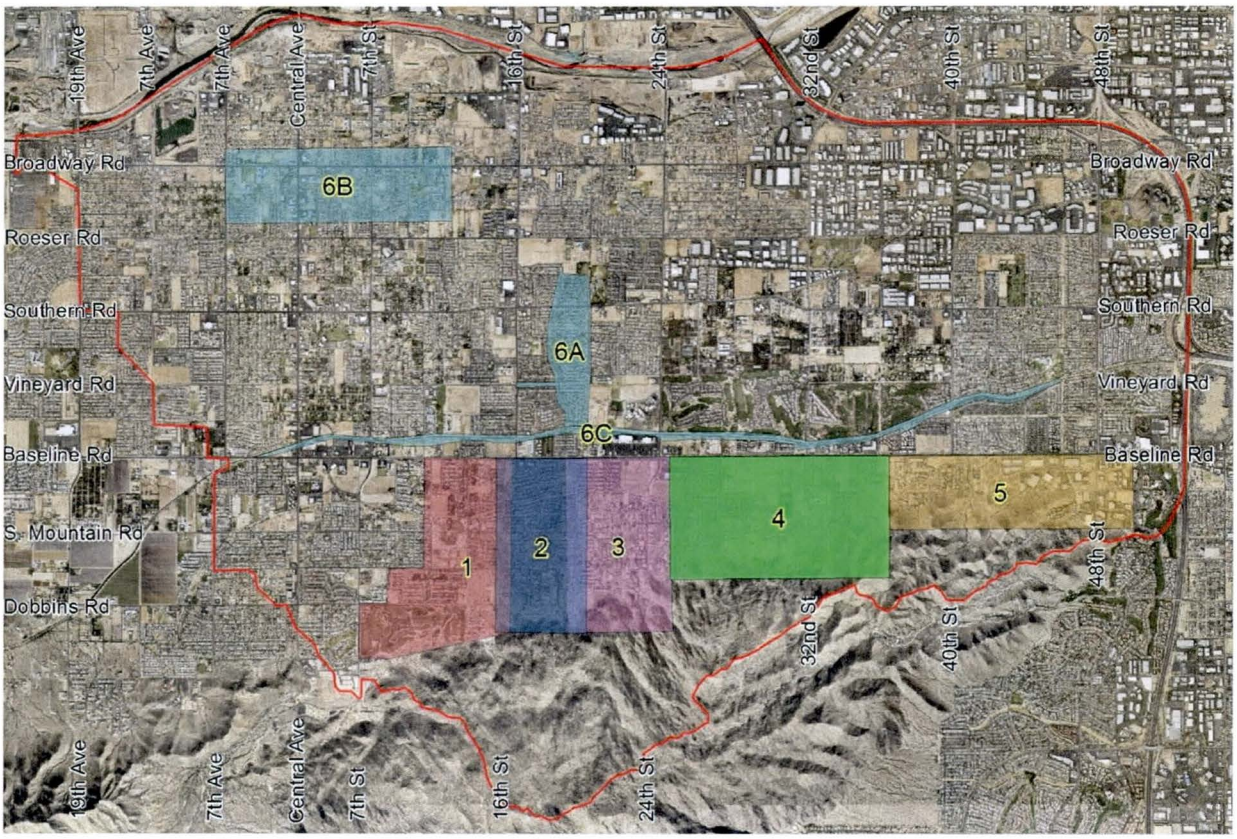

Figure 7-1: Brainstorming Areas

7.2 BRAINSTORMED ALTERNATIVES

This section summarizes the alternatives developed as part of the brainstorming session. Alone, the specific concept summarized may not achieve the desired flood mitigation but may be proposed as a component of an alternative comprised of multiple concepts.

7.2.1 Area 1: 7th St – 16th St (Circle K Park)

1) Dobbins Rd Channel: Channel east-west along Dobbins Road as a means to capture and convey mountain runoff (9th St to 20th St)

2) 16th St/Dobbins Basin: Basin in vacant parcel northwest of 16th St and Dobbins

3) Basin south of Circle K Park: Purchase low density residential parcels south of the park for a basin

4) Circle K Park Basin: Rebuild/regrade Circle K Park to provide retention

5) Basin Northwest of Circle K Park: Basin in vacant parcel north of Highline Canal and west of park

6) Siphon under Highline Canal: Construct siphon under Highline canal (to convey floodwater to above basin north of Highline Canal)

7) Improvements to be included as part of golf course development: Require/work with future development of Thunderbird Country Club Golf Course/Vistal Development to assure and possibly to provide additional improvements for area flood mitigation (retention, channel)

8) Dobbins/20th St Basins: Basin in vacant area southeast of Dobbins/20th St (south of Siesta Foothills)

7.2.2 Area 2: 16th St – 20th St (Siesta Foothills/Boy Scout Camp)

1) Boy Scout Camp Basin System (Eastern System):
   a. Capture Boy Scout Camp Wash flows into a basin southeast of Dobbins
   b. Convey to a larger basin
   c. Convey from basins via new storm drain in 20th St.
   d. Scalp peak with basins on either side of 20th St (or Highline Canal) subject to Baseline storm drain capacity

2) 16th St Basins and Storm Drain (Western System):
   a. Basin upstream of Dobbins at 16th St

b. Route flows from basin under Dobbins via pipe to a basin northwest of 16th St and Dobbins (southeast of Euclid & 14th St).
c. Discharge basin into storm drain along 16th St
d. Discharge storm drain to Baseline Rd storm drain

3) Boy Scout Camp Offline Basin System (Eastern System):
   a. Offline basin to boy Scout Camp Wash flows
   b. Convey westerly via channel to Western System Alternative (above)

4) Boy Scout Camp Offline Basin System 2 (Eastern System):
   a. Offline basin to boy Scout Camp Wash flows
   b. Convey flow by storm drain to along Euclid and west to storm drain system in 16th St.

7.2.3 Area 3: 20th St – 24th St (Pines at South Mountain)

1) String of Pearls System: Series of channel and basins along the existing flow path west of 23rd Pl. Take flow to basins at northwest corner of 24th St / Highline Canal.

2) Highline Canal Channel: Channel to deliver flow to a basin(s) at northwest corner of 20th St / Highline Canal and/or at northwest corner of 24th St / Highline Canal

3) Dikes along base of mountains: Dike system along base of mountains

4) Channel along base of mountains: Channel system along base of mountains

5) Mountain Dam: Dam across major flow west of 24th St in mountains.

6) Dam at 24th St: Dam at 24th St and Euclid

7) Canal Storm Drain System: Storm drain system parallel to Highline Canal. Discharge to extensions of the existing storm drain system south of Baseline Rd.

8) East String of Pearls: Series of basins that delivers flow to a big basin at Baseline and 24th St.

9) Increase park retention: Enlarge existing retention in park

10) Move/Remove Houses: Move all houses.

11) Spillways from Highline Canal: Provide spillways in Highline Canal to detention basins.

7.2.4 Area 4: 24th St – 36th St (Cortland Point)

1) 28th St & South Mountain System:
   e) Basins south of Winston
   f) Outfall storm drain 27th St to South Mountain Ave
   g) Collector storm drains in South Mountain Ave
   h) Outfall basins at Puerto Park

2) 32nd St & Highline Canal System:
   f) Bleed-off storm drain to 24th St storm drain
   g) Collector storm drain at South Mountain Ave from 30th St to 32nd St
   h) Collector storm drain on south side of Highline Canal from 34th St-32nd St
   i) Outfall storm drain and basin at 32nd St (basin west side of 32nd St north of Highline Canal.)
   j) Bleed off storm drain on 32nd St north to Baseline

3) 36th St & Highline Canal System:
   d) Small basins along the Highline Canal to either the north or south side from 34th Pl to 36th St
   e) Channel/floodwall on north side of Highline Canal from 34th Pl to 36th St outfalling to basin(s)
   f) Outfall storm drain north in 36th St to Baseline then west in Baseline to 32nd St storm drain.

7.2.5 Area 5: 36th St – 48th St (South Mountain Industrial Area)

1) 42nd St or 42nd Pl / Baseline Basin: Basin at end of wash south of Baseline. Bleed off to existing storm drain in Baseline. Potential multi-use opportunity as a trailhead for park

2) Basin at Beverly Road S of Highline Canal: Basin southwest of 14th St and Vineyard

7.2.6 Area 6A: 16th St – 20th St (North of Western Canal)

1) Storm Drain: Provide a storm drain system along 18th St, 20th St and/or Vineyard to capture flows.

2) 16th St / Vineyard Basin: Basin in undeveloped area west of 20th St & south of Vineyard (undeveloped property belonging to South Mountain Community College)

3) 14th St / Vineyard Basin: Basin southwest of 14th St and Vineyard

4) 16th St / Vineyard Basin; Basin northwest of 16th St and Vineyard

7.2.7 Area 6B: 3rd St & Broadway (Low Laying Area)

1) Multiple Small Basins: Provide retention in available vacant parcels in general areas that bleed to the storm drain on Broadway or Central

2) Extend/expand storm drain into/in the area to alleviate flooding (and bleed basins): Extend the storm drain systems from Central and/or Broadway into area to capture flows and provide a means to bleed off multiple small retention basins.

7.2.8 Area 6C: Ponding along the south side of Western Canal

1) Basins along south side of Canal: Provide a storm drain system along 18th St, 20th St and/or Vineyard to capture flows.

2) No Action: Expectation that improvements upstream would address and/or alleviate ponding along the canal.

7.3 SEED IDEAS

Prior to the brainstorming session, 48 seed ideas were conceived for the twenty one problem locations previously described (Section 4.4) and for general areas in order to address more widespread or systemic problems such as storm drain deficiencies, flooding along the Highline Canal and future development. These seed ideas are summarized in a table provided in Appendix C. The table briefly describes the idea then indicates which problem areas the idea would address and the nature of the impact on the flooding location. Because many of the flooding issues are interconnected, the impact of a seed idea was categorized as being either "primary" or "secondary". A "primary" impact would indicate the idea would have a direct impact on flows contributing to the flooding problem at that specific location. A "secondary" impact would indicate the idea would have a lesser or more indirect impact on the flooding problems.

These seed ideas were not presented to the participants as part of the brainstorming session, so as not to influence or bias potential ideas generated by the attendees. Many of the seed ideas were similarly envisioned by the brainstorming groups, however, some were not. Consequently, the seed ideas are included for possible consideration in Phase II.

8. PHASE II ALTERNATIVE DEVELOPMENT

8.1 ALTERNATIVE DEVELOPMENT PROCESS

Phase II, the Hohokam Area Drainage Master Plan (ADMP), will utilize the results of the ADMS to formulate flood mitigation alternatives and through three levels of alternative formulation, analysis and evaluation, ultimately make recommendations for drainage improvements for the study area. The ADMP will expand upon the public outreach and involvement efforts and develop concept plans for recommended improvements. Recommended improvements will be prioritized and an implementation plan will be prepared.

8.1.1 Level 1: Alternatives Formulation and Preliminary Analysis

For Level 1, the developed brainstorming alternatives and seed ideas generated in Phase I will be utilized, in part or in their entirety, to develop more comprehensive alternatives for each problem area to be evaluated further in Level 2. The preliminary analysis and evaluation of alternatives will be based upon information available from the Phase I hydrologic & hydraulic analyses and other data collection efforts. A preliminary evaluation matrix will be developed and used to help assess and identify alternatives for further development and assessment in Level 2.

8.1.2 Level 2: Alternatives Analysis

For Level 2, alternatives will be further developed to determine the engineering feasibility, effectiveness and approximate costs. The alternatives will be developed to an extent to identify potential utility impacts, ROW/land acquisition requirements, potential multi-use opportunities, and environmental/cultural resource issues. Integral to the development and assessment of the alternatives will be the District's CSFHM approach that will consider flooding context, land and resource context and community text. A more detailed evaluation will be used to assess project alternatives and public input will be obtained and considered as part of the community context to identify recommended alternatives for further development in Level 3.

8.1.3 Level 3: Recommended Alternatives Analysis

Level 3 will develop the recommended alternatives to a level at which 15% plans can be completed. Hydrologic and hydraulic models will be developed to reflect the recommended alternatives. A landscape and multiple-use guidelines along with an implementation plan will be developed to guide future development and provide a strategy for implementation. Public meetings will be held to present the recommended alternatives.

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APPENDIX A

Flood Insurance Rate Maps (FIRMs)

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **Community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles, Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Geodetic Vertical Datum of 1929 (NGVD 29). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Arizona State Plane Zone 2101 (Central Arizona). The **horizontal datum** was NAD83 (1986) spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the National Geodetic Vertical Datum of 1929. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

Spatial Reference System Division
National Geodetic Survey, NOAA
Silver Spring Metro Centre
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242** or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from multiple sources. Base map files were received in digital format by Mercator County. Orthophoto images were produced at a scale of 1:6000 using HARN to control. Aerial photography is dated December 2000 to December 2002.

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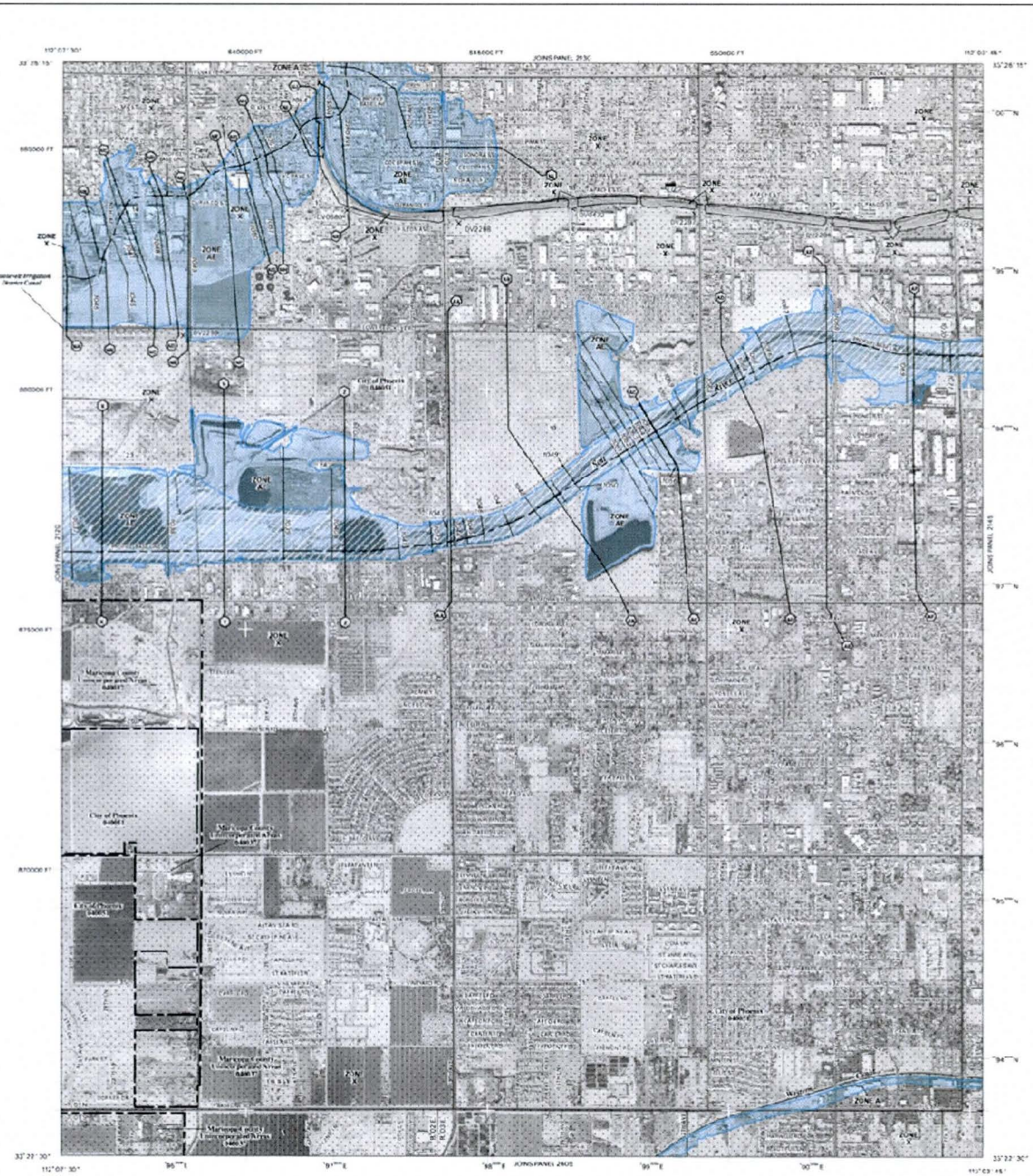
Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map**, or questions concerning the National Flood Insurance Program in general, please call 1-877-FEMA MAP (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood.

ZONE A — No Base Flood Elevations determined.

ZONE AE — Base Flood Elevations determined.

ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE A1 — A30 — Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE V1 — V30 — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from the 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the National Geodetic Vertical Datum of 1929

A — A — Cross section line

B — B — Transect line

97°07'30", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

4275000 m — 1000-meter Universal Transverse Mercator grid ticks, zone 12S

5000 foot grid ticks based on Arizona State Plane coordinate system, central zone (FIPSZONE 3738), Transverse Mercator projection

DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 — River Mile

MAP REPOSITORY
Refer to Repositories listing in Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
April 15, 1985

EFFECTIVE DATE OF REVISION(S) TO THIS PANEL
September 30, 2005

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2140G

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 2140 OF 4350

COMMUNITY — NUMBER — PANEL — SUFFIX

MAP NUMBER
04013C2140G
MAP REVISED
SEPTEMBER 30, 2005

Federal Emergency Management Agency

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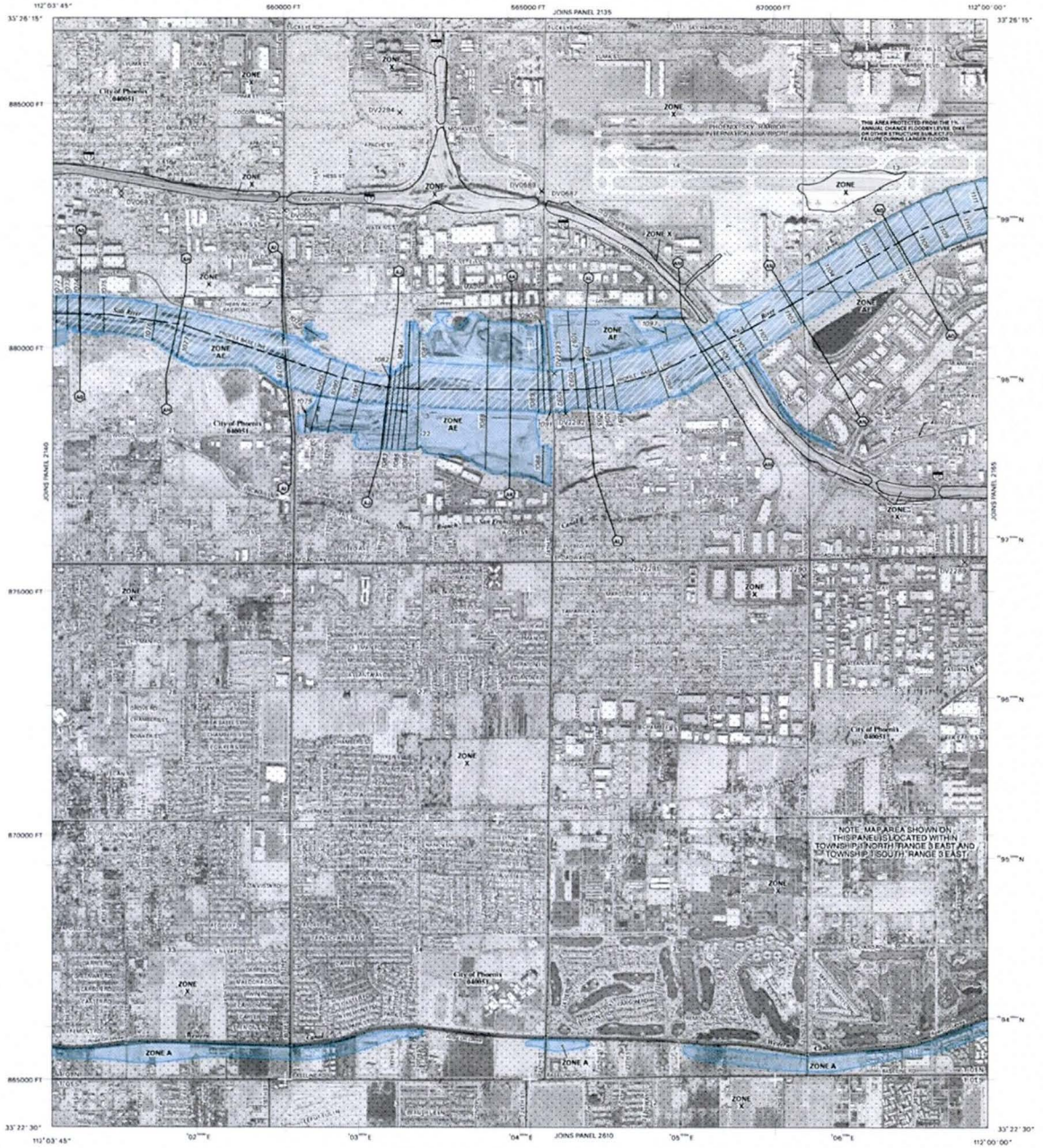
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMAMAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, and VE. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood.

ZONE A — No Base Flood Elevations determined.

ZONE AE — Base Flood Elevations determined.

ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR — Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 — Area to be protected from 1% annual chance flood by a federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the National Geodetic Vertical Datum of 1929

A–A — Cross section line

7–7 — Transect line

112°03'08", 33°25'45" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

-75°—E — 1000-meter Universal Transverse Mercator grid ticks, zone 12

875000 FT — 5000-foot grid ticks based on Arizona State Plane coordinate system, Central zone (FIPSZONE 3179), NAD83 (Transverse Mercator)

BM5513 — Bench mark (see explanation in Notes to Users section of this FIRM panel)

• M1.5 — River Mile

MAP REPOSITORY
Refer to Repositories listing on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
April 15, 1998

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
December 3, 1992, September 30, 1995, July 19, 2001

September 30, 2005 - to update corporate limits, to change Base Flood Elevations, to add Base Flood Elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to change zone designations, to add roads and road names, to incorporate previously issued Letters of Map Revision, and to incorporate previously issued Letters of Map Amendment.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2145H

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 2145 OF 4350

PANEL LAYOUT

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
PHOENIX, CITY OF	040051	2145	H

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
04013C2145H
MAP REVISED
SEPTEMBER 30, 2005

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles, Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' National Geodetic Vertical Datum of 1929 (NGVD 29). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was *Arizona State Plane Zone 1176 (central Arizona)*. The **horizontal datum** was *NAD83, GRS80 spheroid*. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the *National Geodetic Vertical Datum of 1929*. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

Spatial Reference System Division
National Geodetic Survey, NOAA
Silver Spring Metro Center
1315 East-West Highway
Silver Spring, Maryland 20910
(310) 713-3191

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from multiple sources. Base map files were provided in digital format by Maricopa County. Orthophotic images were produced at a scale of 1:6000 using rectified controls. Aerial photography is dated December 2000 to December 2002.

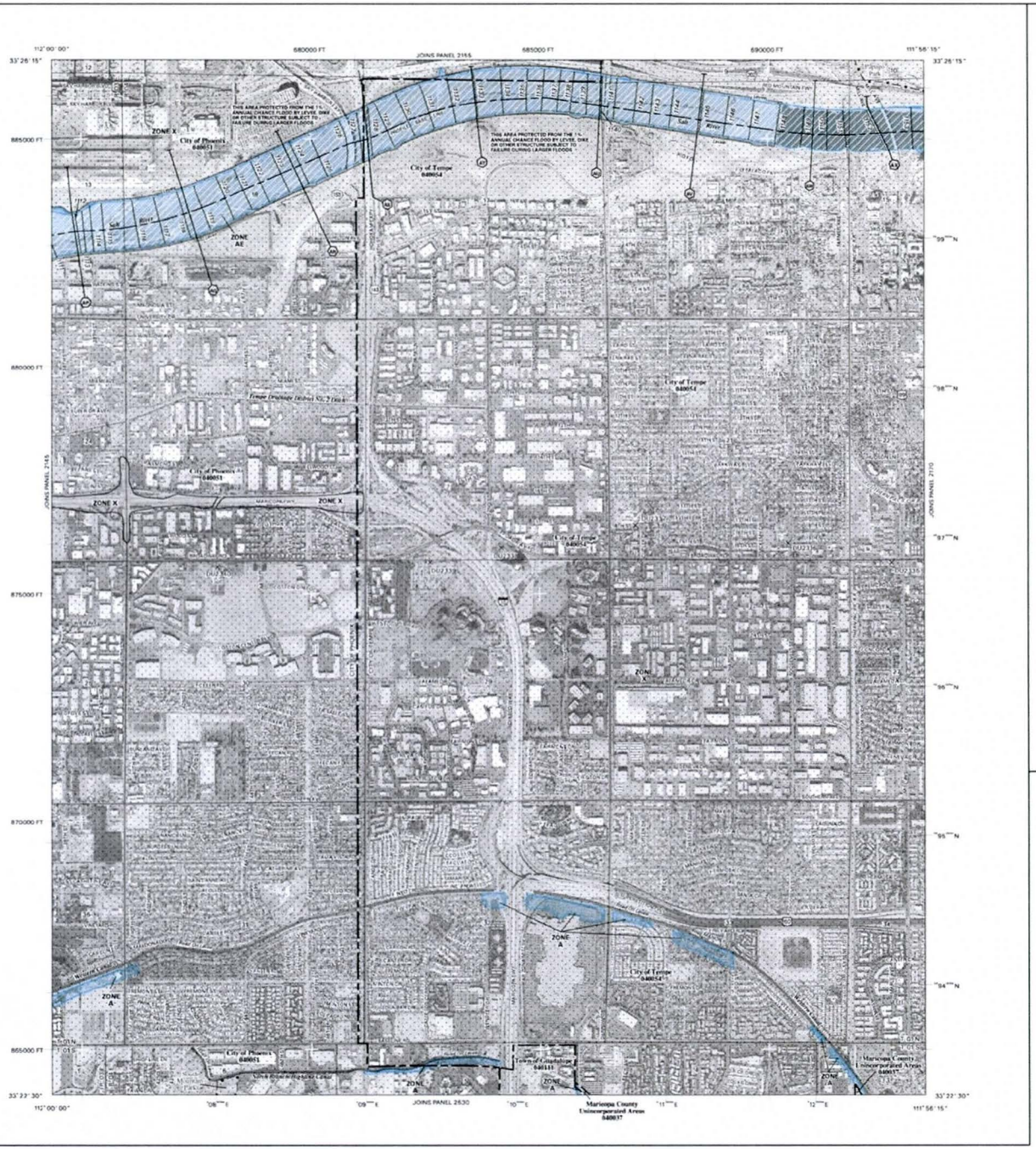
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a listing of Communities Table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMAMAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, A1-A30, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A — No Base Flood Elevations determined.
ZONE AE — Base Flood Elevations determined.
ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR — Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increase in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the National Geodetic Vertical Datum of 1929

A — A — Cross section line
23 — 97 — Transect line

112° 07' 08", 33° 25' 41" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), World Geodetic System 1984 (WGS 84). Western hemisphere

32 mE — 1000-meter Universal Transverse Mercator grid ticks, zone 12

875000 FT — 5000-foot ticks: Arizona State Plane coordinate system, central zone (FIPS ZONE 3176), NAD83 (Transverse Mercator)

DV2313 — Bench mark (see explanation in Notes to Users section of this FIRM panel)

• M1.6 — River Mile

MAP REPOSITORY
Refer to Repositories Listing on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
April 15, 1988

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
December 3, 1993; September 30, 1998; July 19, 2001

September 30, 2005 - to update corporate limits, to change Base Flood Elevations, to add Base Flood Elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to change zone designations, to add levees, and to incorporate previously issued Letters of Map Amendment and Letters of Map Revision, and to incorporate previously issued Letters of Map Amendment.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2165H

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 2165 OF 4350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINING:

COMMUNITY	NUMBER	PANEL	SUFFIX
GUADALUPE, TOWN OF	040111	2165	H
MARICOPA COUNTY	040037	2165	H
PHOENIX, CITY OF	040051	2165	H
TEMPE, CITY OF	040054	2165	H

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
04013C2165H
MAP REVISED
SEPTEMBER 30, 2005

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles, Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' National Geodetic Vertical Datum of 1929 (NGVD 29). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Arizona State Plane Zone 3119 (central Arizona). The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the National Geodetic Vertical Datum of 1929. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at: http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

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National Geodetic Survey, NOAA
Silver Spring Metro Center
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from multiple sources. Base map files were provided in digital format by Maricopa County. Orthophoto images were produced at a scale of 1:6000 using NAIRN for control. Aerial photography is dated December 2000 to December 2002.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels, community map repository addresses, and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

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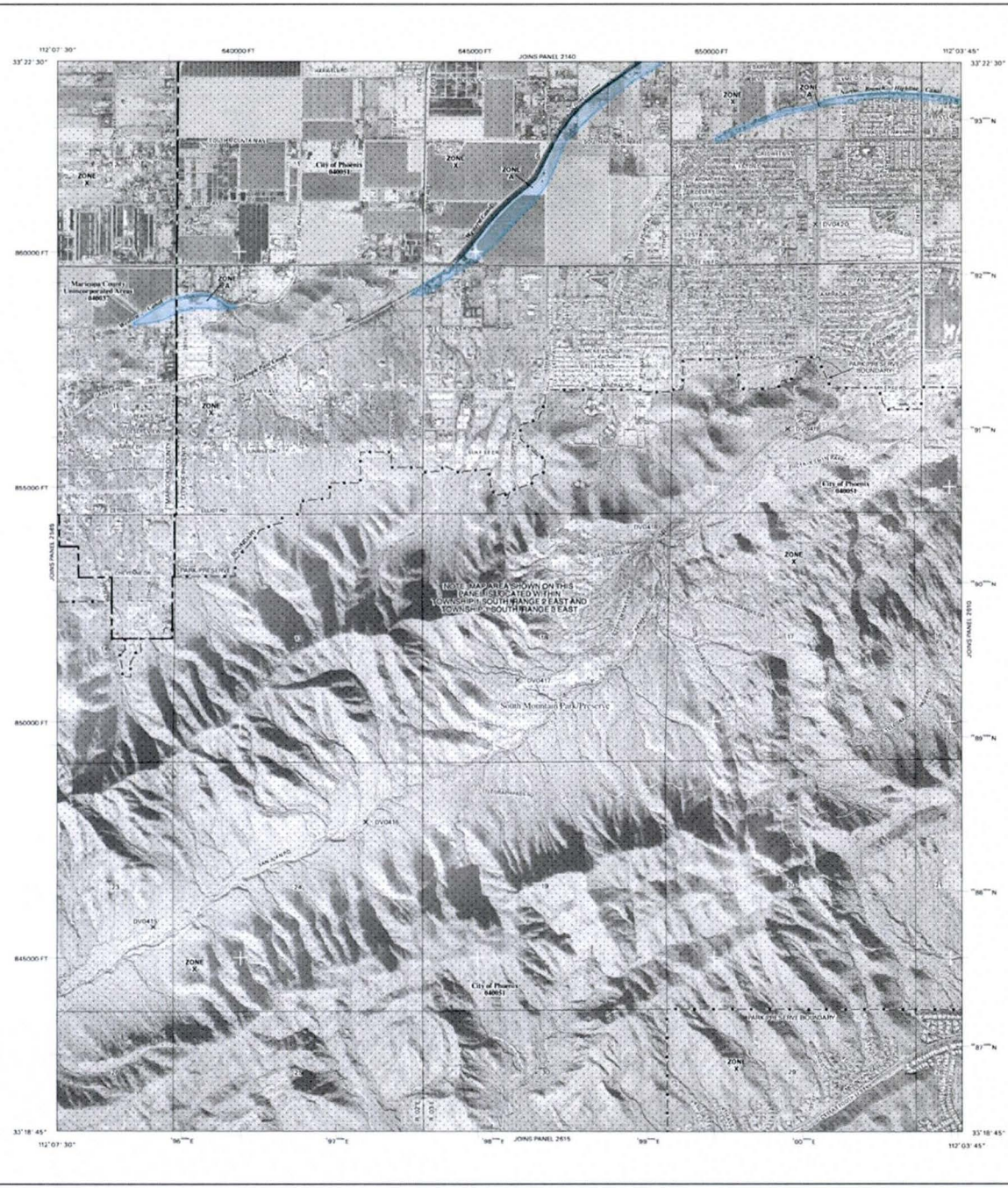
If you have **questions about the map**, or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMAMAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas on flood insurance rate maps include Zones A, AE, AH, AO, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A — No Base Flood Elevations determined.

ZONE AE — Base Flood Elevations determined.

ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR — Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Area of different Base Flood Elevations, flood depths, or flood velocities.

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the National Geodetic Vertical Datum of 1929

A — Cross section line

A — Transect line

112°07'08", 33°25'45" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

4275000 mN — 1000-meter Universal Transverse Mercator grid ticks, zone 12

275000 FT — 1000-foot grid ticks values: Arizona State Plane coordinate system, central zone (FIPSZONE 3119), NAD83 (Transverse Mercator)

DV2313 — Bench mark (see explanation in Notes to Users section of this FIRM panel)

M5.5 — River Mile

MAP REVISIONS

Refer to Revisions Listing on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

April 15, 1988

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

July 19, 2001

September 30, 2005 - to update corporate limits, to change Base Flood Elevations, to add Base Flood Elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to change zone designations, to add levees and flood control systems, to add floodways, to incorporate Map Revisions, and to incorporate previously issued Letters of Map Revision, and to incorporate Map Revisions with Acceptance.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2605F

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 2605 OF 4350

PANEL LAYOUT

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	2605	F
PHOENIX, CITY OF	040051	2605	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
04013C2605F
MAP REVISED
SEPTEMBER 30, 2005

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles, Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0 National Geodetic Vertical Datum of 1929 (NGVD 29). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Arizona State Plane Zone 3176 (Central Arizona). The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the National Geodetic Vertical Datum of 1929. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

Spatial Reference System Division
National Geodetic Survey NOAA
Silver Spring Metro Center
1315 East-West Highway
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To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from multiple sources. Base map files were provided in digital format by Maricopa County. Orthophoto images were produced at a scale of 1:1000 using IKAPA for control. Aerial photography is dated December 2000 to December 2001.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

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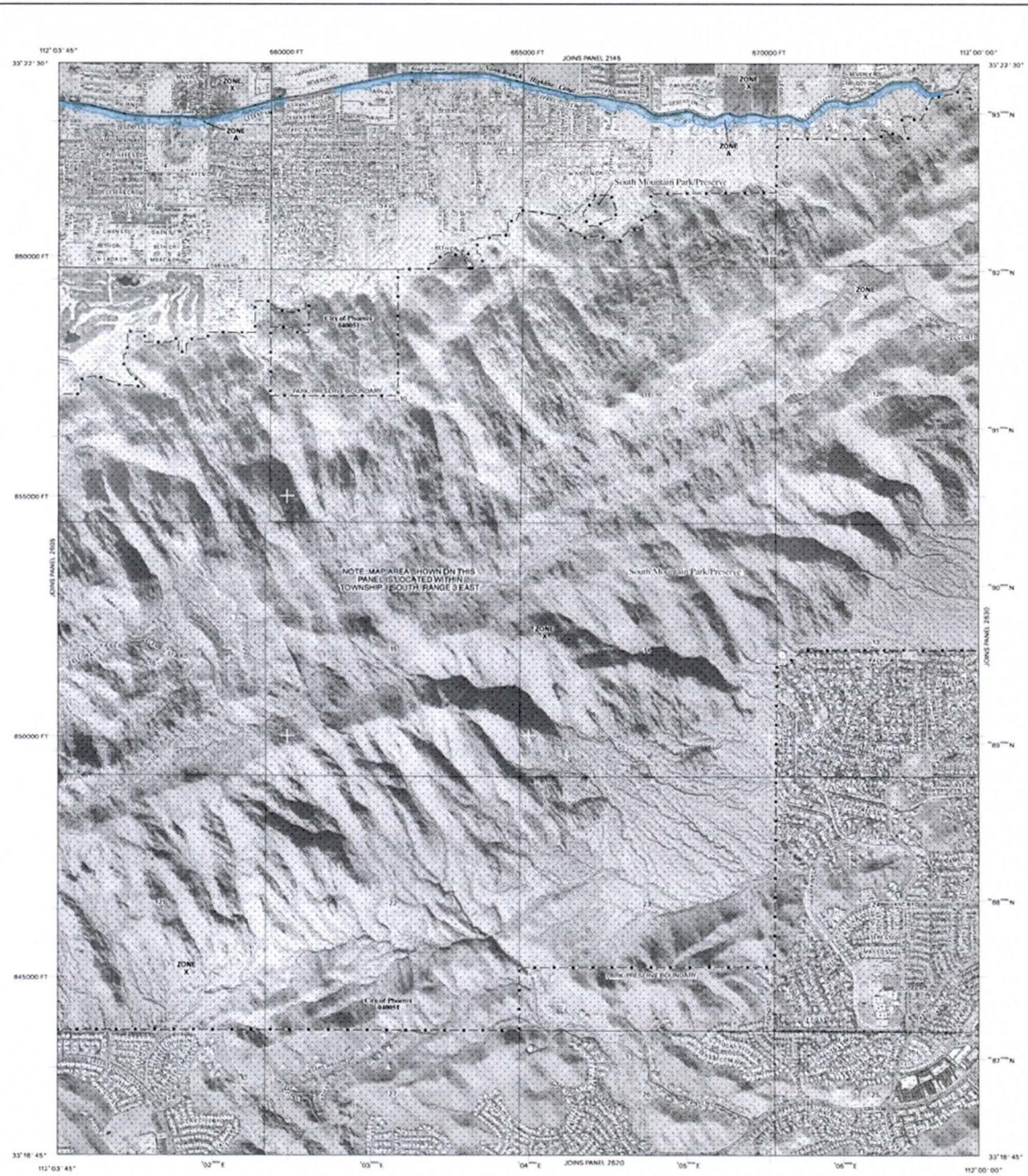
Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov.

If you have **questions about this map**, or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMAMAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100 year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, A1-A30, AR, A99, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A — No Base Flood Elevations determined.

ZONE AE — Base Flood Elevations determined.

ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR — Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 — Area to be protected from 1% annual chance flood by a federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

513 — Base Flood Elevation line and value; elevation in feet*

EL 987 — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the National Geodetic Vertical Datum of 1929

A — A — Cross section line

Transect line

112°07'08", 33°25'41" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

3276000 FT — 1000-meter Universal Transverse Mercator grid ticks, zone 12

875000 FT — 5000-foot grid ticks: Arizona State Plane coordinate system, central zone (FIPSZONE 3176), NAD83 (Transverse Mercator)

DV2313 — Bench mark (see explanation in Notes to Users section of this FIRM panel)

MAP REPOSITORY

Refer to Repositories Listing on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

April 15, 1988

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

July 16, 2001

September 30, 2005 - to update corporate limits, to change Base Flood Elevations, to add Base Flood Elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to change zone designations, to add roads and road names, to incorporate previously issued Letters of Map Revision, and to incorporate previously issued Letters of Map Amendment.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2610F

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 2610 OF 4350

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
PHOENIX, CITY OF	040051	2610	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
04013C2610F
MAP REVISED
SEPTEMBER 30, 2005

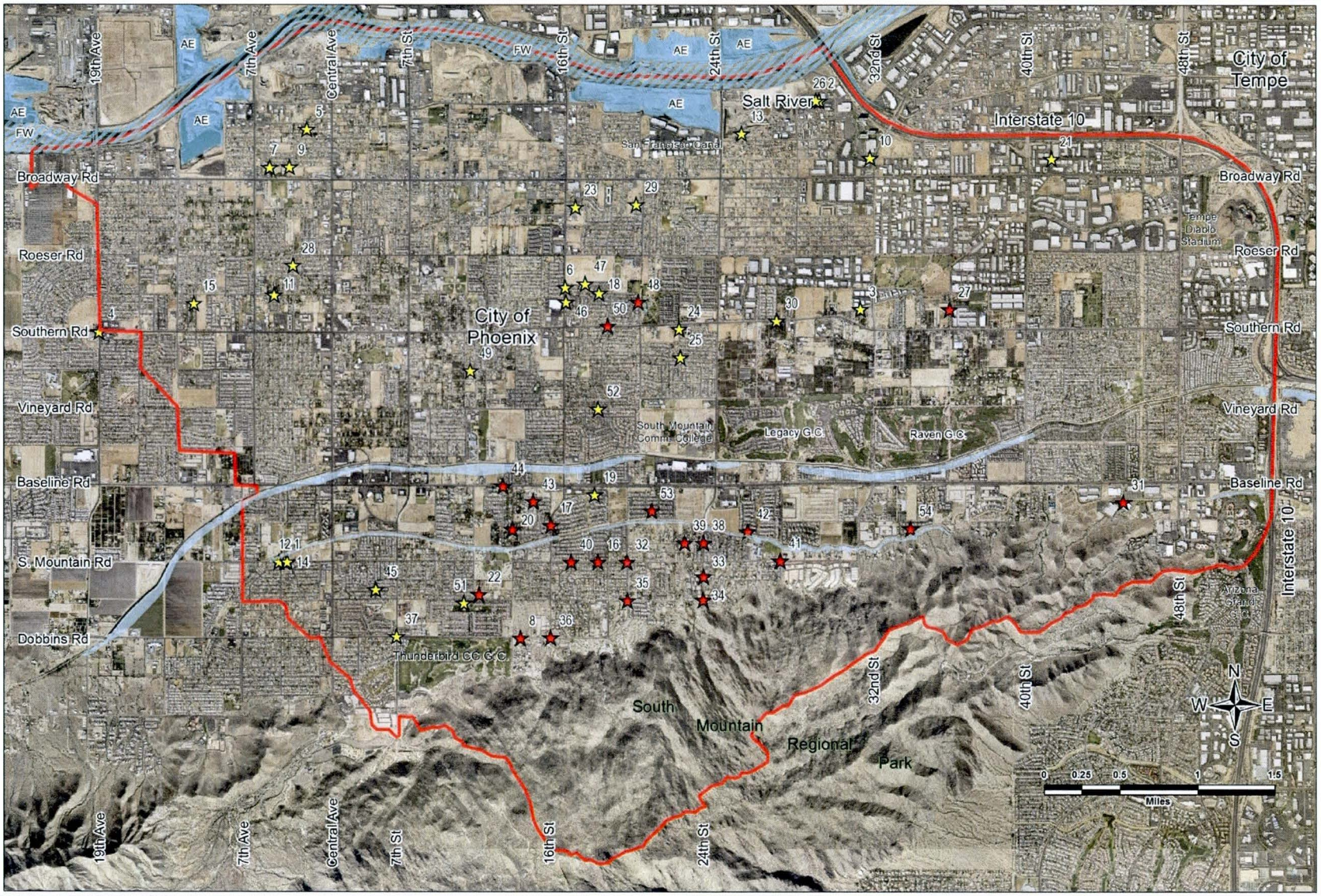
Federal Emergency Management Agency

APPENDIX B

DRAINAGE COMPLAINTS EXHIBIT

Hohokam Area Drainage Master Study/Plan

Contract FCD2009C029



Stanley Consultants INC.

JE FULLER HYDROLOGY & GEOMORPHOLOGY, INC.

Legend

ADMS Boundary

Drainage Complaints

- Local Issue
- Regional Issue

Flood Hazard Zone

- Zone A
- Zone AE
- Floodway

Notes
Aerial photography dated October 2009
Topographic mapping a composite of multiple sources converted to NAVD 88 (vertical) and NAD1983 HARN State Plan Arizona Central FIPS 0201 Ft (international)

Drainage Complaint Locations
Exhibit

APPENDIX C

SEED IDEAS

Seed Alternatives for Hohokam ADMS

	Description	Montana Vista (16th St. & Dobbins Rd.)	16th St. from Dobbins Rd. to Baseline Rd.	Circle K Park (14th St. & South Mountain Ave.)	Thunderbird CCGC (7th St. & Dobbins Rd.)	S. Mountain Ave. & 17th Way	Vista Portica (17th Way & S. Mountain Ave.)	Pines at South Mountain (21st Way & Baseline Rd.)	Siesta Foothills Area (20th St. & Euclid Ave.)	21st Pl. & Euclid Ave.	22nd St. – 24th St., North of S. Mountain Ave.	25th Pl. – 32nd St., Ponding Along Highline Canal	Cortland Point (36th St. & Highline Canal)	Shadow Mtn Villas (36th St. & Baseline Rd.)	42nd St. & Baseline Rd.	46th St. & Beautiful Lane	Ponding along the Western Canal	Vineyard Rd/18th St/ 19th Pl/20th St	Contempo Tempe Mobile Home Park	S. Mountain Community College (SMCC)	2nd St. & Weir Ave	19th St from Euclid Ave to Highline Canal	Along Highline Canal	Storm Drain Deficiencies	Future Developments		
	Concept	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	A	B	C	D	E
1	New retention basin in vacant parcel north/west of Montana Vista. Could also provide retention of flow thru TGCC/Vistal and alleviate 16th St.	P	P	P	P																						
2	Retention basins in several parcels south of Dobbins Rd at 16th St	P	P	S																							
3	Channelize flow & new culvert across Dobbins, extend rectangular channel downstream of MV to a (new) nearby retention basin.	P	P	S																							
4	New retention basin at: * NW of S Mtn & 16th St *S of Baseline & W of 16th St		P	S																							
5	New 16th St storm drain connected to * Baseline storm drain * new retention basins along 16th St		P	S																							
6	Modify Dobbins Creek basins to improve retention (expand, modify to balance flow between basins, change distribution of flow to basins)			P	P																						
7	COP to stipulate Vistal development to provide sufficient retention and distribute flow to reduce downstream flooding.			P	P																						
8	Retention basin in Circle K Park (in desert landscape area)		S	P																							
9	Retention basin in vacant land north of Circle K Park between 12th St and 13th St.			P																							
10	Retention basin in vacant land east of 14th St and north of Circle K park.			P																							
11	Provide retention basin in boy scout camp facility					P	P	P	S																		
12	Storm drain along 17th Way and S. Mtn to downstream retention or storm drain system					P	P	S																			
13	Construct inverted crown road along 17th Way and S. Mtn and then collect flow into a storm drain or retention basins					P	P	S																			
14	19th or 20th St storm drain/conveyance from Dobbins or Euclid to downstream retention or to extension of storm drain system.					P	P	S	S													P					
15	Retention basin in vacant land S of Siesta Foothills & E of Dobbins/20th St							P	P													P					
16	Storm drain from Siesta Foothills culvert to a retention basin at the SE or NW corner of 20th St & Highline Canal or to storm drain system							P	P																		
17	Inverted crown road to convey more fole to drainage easement									P																	

Seed Alternatives for Hohokam ADMS

	Description	Montana Vista (16th St. & Dobbins Rd.)	16th St. from Dobbins Rd. to Baseline Rd.	Circle K Park (14th St. & South Mountain Ave.)	Thunderbird CCGC (7th St. & Dobbins Rd.)	S. Mountain Ave. & 17th Way	Vista Portica (17th Way & S. Mountain Ave.)	Pines at South Mountain (21st Way & Baseline Rd.)	Siesta Foothills Area (20th St. & Euclid Ave.)	21st Pl. & Euclid Ave.	22nd St. – 24th St., North of S. Mountain Ave.	25th Pl. – 32nd St., Ponding Along Highline Canal	Cortland Point (36th St. & Highline Canal)	Shadow Mtn Villas (36th St. & Baseline Rd.)	42nd St. & Baseline Rd.	46th St. & Beautiful Lane	Ponding along the Western Canal	Vineyard Rd/18th St/ 19th Pl/20th St	Contempo Tempe Mobile Home Park	S. Mountain Community College (SMCC)	2nd St. & Weir Ave	19th St from Euclid Ave to Highline Canal	Along Highline Canal	Storm Drain Deficiencies	Future Developments		
	Concept	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	A	B	C	D	E
18	Retention basin E of 22nd Pl and N and/or S of S. Mtn Ave							S			P																
19	Retention Basin NE and NW of Highline Canal and 24th St							P	P	S	P	P															
20	Channel from South Mountain Ave to north of Highline Canal between 22nd Pl and 23rd Pl alignments.							S	S		P																
21	Retention Basin Sof Winston and 27th St											P															
22	Expand existing retention basin E of 28th St and S of S.Mtn Ave											P															
23	Retention Basin N of Highline and W of 32nd St.											P										P					
24	Collector channel or storm drain along Valley View Dr W of Patricia St and along Patricia St (along edge of S. Mtn Park)											P															
25	Retention basin along Patricia St S of Winston Dr (near 27th St and edge of S. Mtn Park)											P															
26	Retention upstream of Canal at Cortland Point												P	S													
27	Retention basin N of Highline Canal and E of 36th St												P	S													
28	At Cortland Pt, Regrade behind block walls along the Highline Canal to drain flow to the east.												P	S													
29	Retention basin along S of Baseline and W of 42nd St														P												
30	Increase 40th St Storm Drain Capacity to accomodate some flow														P												
31	Retention Basin S of Beautiful Lane and W of 46th St upstream of existing building															P											
32	Retention Basin W of 48th St and N of Beverly Lane															P											
33	Expand retention basin NW of 24th St and Western Canal, construction collector channel along N side of Western Canal to convey flow to basin.																S			P							
34	Where possible, construction a collector channel along the S side of the conal to divert flow to retention basins																P										
35	Retention Basin in vacant land N of Wetern Canal and W of SMCC (around track)																	P		S							
36	Extend a storm drain lateral from 16th St down Vineyard Rd to 19th Pl																	P									
37	Extend storm drain laterals from Southern Ave down 18th St and 20th St																	P									
38	Retention Basin in mobile home park just SE of existing Basin																		P								

Seed Alternatives for Hohokam ADMS

	Description	Montana Vista (16th St. & Dobbins Rd.)	16th St. from Dobbins Rd. to Baseline Rd.	Circle K Park (14th St. & South Mountain Ave.)	Thunderbird CCGC (7th St. & Dobbins Rd.)	S. Mountain Ave. & 17th Way	Vista Portica (17th Way & S. Mountain Ave.)	Pines at South Mountain (21st Way & Baseline Rd.)	Siesta Foothills Area (20th St. & Euclid Ave.)	21st Pl. & Euclid Ave.	22nd St. – 24th St., North of S. Mountain Ave.	25th Pl. – 32nd St., Ponding Along Highline Canal	Cortland Point (36th St. & Highline Canal)	Shadow Mtn Villas (36th St. & Baseline Rd.)	42nd St. & Baseline Rd.	46th St. & Beautiful Lane	Ponding along the Western Canal	Vineyard Rd/18th St/ 19th Pl/20th St	Contempo Tempe Mobile Home Park	S. Mountain Community College (SMCC)	2nd St. & Weir Ave	19th St from Euclid Ave to Highline Canal	Along Highline Canal	Storm Drain Deficiencies	Future Developments		
	Concept	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	A	B	C	D	E
39	Extend new/expand existing lateral from Broadway S down 2nd St																				P						
40	Construct a basin at SEC of Broadway and Central Ave																				P						
41	Rapid Infiltration Basin or Ret Basin with Rapid Dry Wells at small parcel on SWC of 2nd St and Marguerite Ave																				P						
General Concepts																											
42	Where possible, construction a collector channel along the S side of the canal to divert flow to retention basins			P				P			P	P	P	S		P	P	S					P			
43	Inverted crown roads with storm drain underneath for low flow events.	P	P	P		P	P	S	S	P	P	S	P	S				P	P		P	P					
44	Development of sub-regional storm drain systems south of Broadway. e.g. Dobbins/Euclid/S. Mtn-16th St storm drain	P	P	P																							
45	Utilize Highline Canal to collect flows. Canals drained directly to adjacent retention and/or connected by pipe to retention basins and/or the storm drain system.		P	P				P				S	P	S									P				
46	COP to require stipulations to provide storage along the Highline Canal spacifically to address offsite flows and overtopping of the canal.																								P		
47	"Tile" Highline Canal																										
48	Retention basins in large parcels tthroughout the study area to serve as outfalls to new local storm drain systems or relieve to flow in existing sotrm drain system.	P	P	P		P	S				P	P						P			P	P	P	P		

P indicates the alternative is expected to have a primary impact for the specific problem area
S indicates the alternative is expected to have an impact on the specific problem area but a lesser or secondary impact.