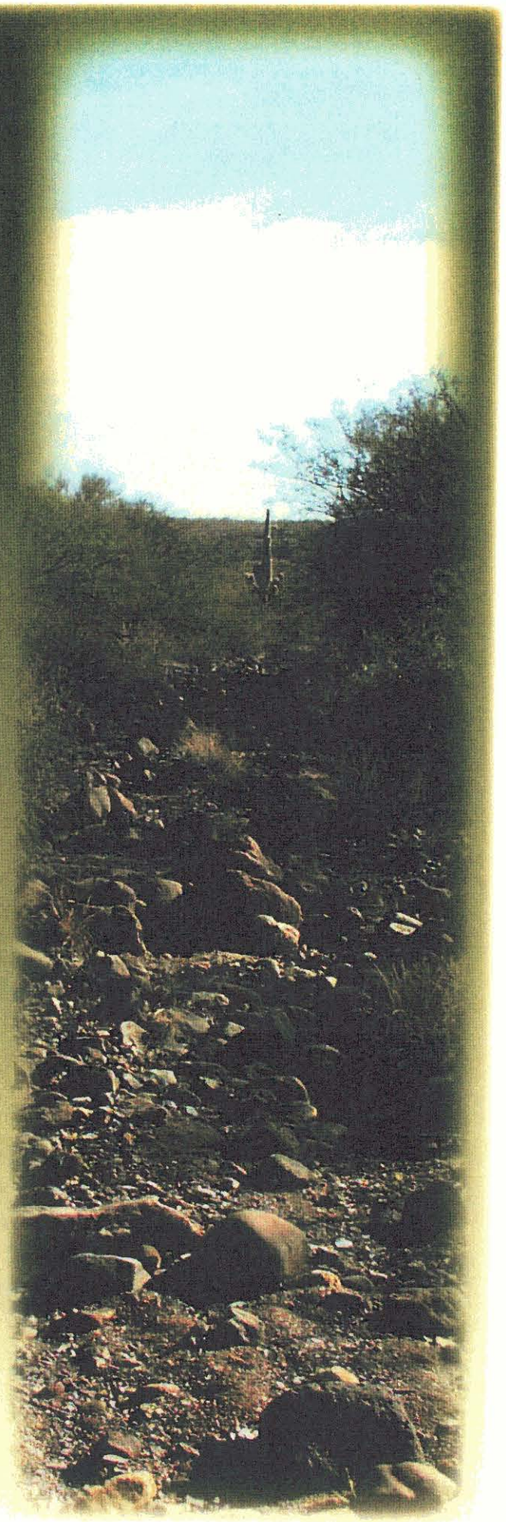
ADOBE
DAM/DESERT HILLS
AREA DRAINAGE MASTER PLAN



Part 8
Phase II
Alternatives Formulation

Volume 3

December 2005

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ADOBE DAM/DESERT HILLS AREA DRAINAGE MASTER PLAN

PHASE II ALTERNATIVES FORMULATION REPORT
PART 8, VOLUME 3

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

CL Williams
Consulting Engineers

LOGAN SIMPSON
DESIGN INC.

Stantec

RBF
CONSULTING

December 2005

PHASE II ALTERNATIVES FORMULATION REPORT
PART 8, VOLUME 3

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ENCLOSED DATA CD INCLUDES:

- **Digital data including a pdf format copy of the report is located in Part 8, Volume 4**

SECTION 1: INTRODUCTION

The purpose of the Phase II Alternatives Formulation Report (Task 4.2.8) for the Adobe Dam/Desert Hills Area Drainage Master Plan (ADMP) is to document the proposed Phase II alternatives, cost estimates, the alternatives evaluation criteria, the evaluation process and results. The advantages and disadvantages of each alternative are identified, considering construction cost, public preferences, environmental impacts, and reliability and life of the project. The outcome of the Phase II alternatives analysis is the Recommended Alternative.

The Phase II report is presented in two volumes. Part 8 Volume 3 contains general information, including a description of the project area, a brief summary of the project scope with emphasis on the Phase II work tasks and deliverables, and a narrative description of the structural and nonstructural alternatives analyzed at Phase II to address the drainage and flooding problems identified in Phase I of the project. Part 8 Volume 3 also documents the evaluation criteria applied to sort and select the Phase II alternatives and presents the resultant Recommended Alternative. Part 8 Volume 4 contains the technical documentation for the alternatives analysis and conceptual design and the Phase II Development Guidelines. Other work products provide detailed information regarding Phase II alternatives and analysis and these are provided under separate cover. These include Part 6 Environmental Overview, Landscape Character Analysis, and Multiple-Use Opportunities Assessment Reports and Part 7 Flood Response Plan.

The ADMP was performed by JE Fuller/Hydrology & Geomorphology, Inc. (JEF), with subconsultants C.L. Williams Consulting, Inc. (CLW), Logan Simpson Design (LSD), Stantec Consulting, Inc. (Stantec), and RBF Consulting (RBF), on behalf of the Flood Control District of Maricopa County (District) under Contract No. FCD2002C001.

SECTION 2: PROJECT AREA DESCRIPTION

The project area for the ADMP is shown in Figure 2.1. The ADMP study area is generally bounded by the Tonto National Forest to the north, Adobe Dam to the south, approximately the 40th Street alignment (north of Carefree Highway) and the 7th Street alignment (south of Carefree Highway) to the east, and the watershed boundary between Skunk Creek and New River to the west. The total project area is approximately 100 square miles. The ADMP study area consists of the Skunk Creek watershed upstream of Adobe Dam plus the Desert Hills Wash and Apache Wash drainage areas, both tributaries to Cave Creek, upstream of the City of Phoenix jurisdictional boundary. The Cave Creek tributaries were included because of their geographic connectivity to the Desert Hills community and the Skunk Creek watershed area.

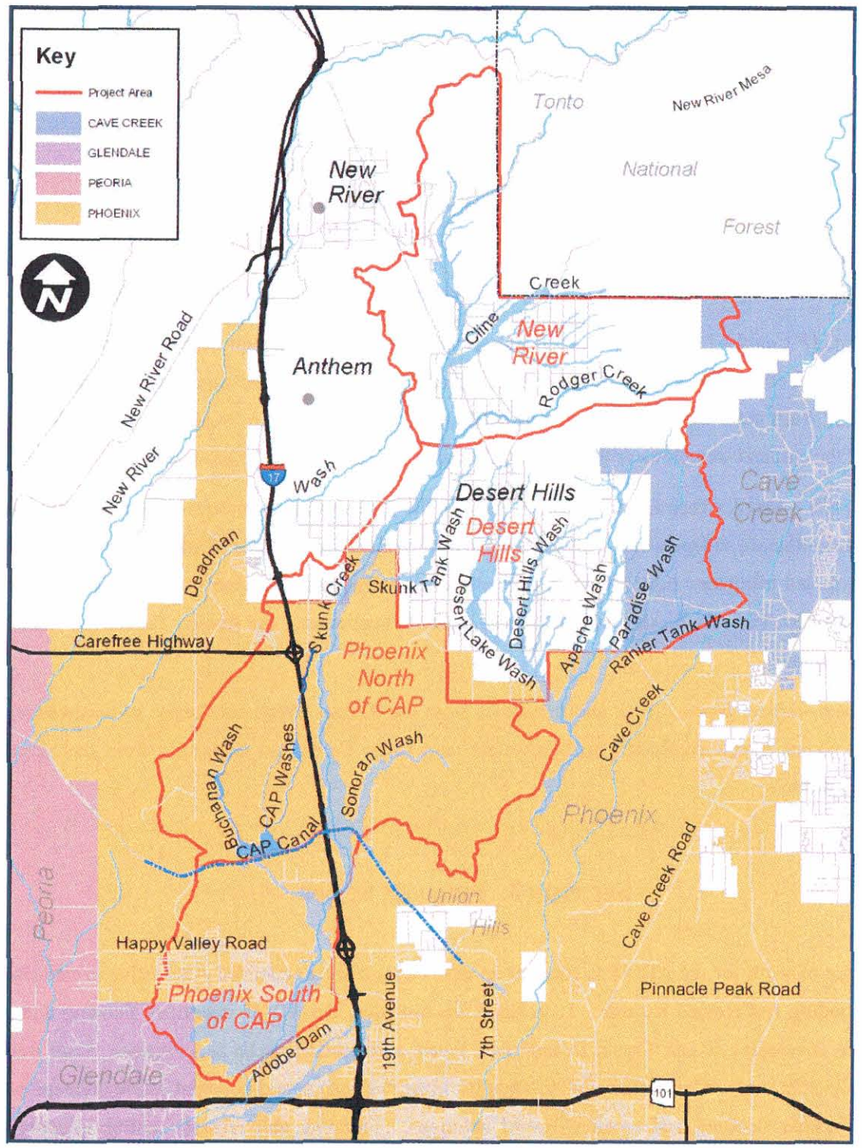


Figure 2.1 Adobe Dam/Desert Hills ADMP Study Area

The study area was further subdivided into four subareas initially: Phoenix South of the Central Arizona Project aqueduct (CAP), Phoenix North of CAP, Desert Hills, and New River (see Figure 2.1). The Phoenix South of the CAP and Phoenix North of the CAP subareas were subsequently combined during Phase II into one subarea named Phoenix/CAP Canal. These subareas were identified based on their jurisdictional boundaries and similar watershed characteristics for the purposes of public and stakeholder coordination and technical analyses, respectively. The study area includes four jurisdictions: unincorporated Maricopa County, City of Phoenix, Town of Cave Creek, and City of Glendale.

The major watercourses within each of the three subareas of the ADMP project area are described below:

Phoenix/CAP Canal – Lower Skunk Creek from Adobe Dam to the CAP aqueduct and lower Buchanan Wash from the Skunk Creek confluence to the CAP aqueduct, Skunk Creek from the CAP aqueduct to the Joy Ranch Road crossing, Sonoran Wash from the CAP aqueduct to headwaters, upper Buchanan Wash from the CAP aqueduct to headwaters, and the east and west forks of the CAP Wash from the CAP aqueduct to headwaters;

Desert Hills – Skunk Creek from Joy Ranch Road to the Rodger Creek confluence, Skunk Tank Wash from the Skunk Creek confluence to headwaters, Desert Lake Wash from the Desert Hills Wash confluence to headwaters, Desert Hills Wash and tributaries from the 16th Street alignment to headwaters, upper Apache Wash from Carefree Highway to headwaters, Paradise Wash from Carefree Highway to headwaters, and Ranieri Tank Wash from Carefree Highway to headwaters;

New River – Upper Skunk Creek and tributaries from the Rodger Creek confluence to headwaters, Rodger Creek from the Skunk Creek confluence to headwaters, and Cline Creek and tributaries from the Skunk Creek confluence to headwaters.

SECTION 3: PROJECT SCOPE

The scope of work for the ADMP is focused on developing a Recommended Alternative to mitigate known and potential flooding and erosion hazards. To achieve this outcome, the ADMP quantifies flooding and drainage conditions in the developing Skunk Creek, Desert Hills Wash, and upper Apache and Paradise Wash watersheds; characterizes erosion hazards within delineated floodplains; identifies current and potential future drainage problems; and generates feasible flooding and erosion control solutions. Flooding and erosion control solutions include structural, nonstructural, and no action measures or a combination of these.

The project includes hydrologic, hydraulic, sedimentation and geomorphic evaluations; identification of drainage problems; development of structural and nonstructural alternative solutions; environmental and visual resources overviews, including landscape aesthetics considerations; preparation of concept design plans documenting the structural alternative measures; public and stakeholder coordination; and formulation of an implementation plan for the Recommended Alternative.

3.1 Project Objectives

Arizona Revised Statutes Title 48, Chapter 21 requires the Board of Directors to identify flood control problems and prepare plans which, when implemented, will eliminate or minimize flooding problems. Successful implementation of the recently completed Skunk Creek Watercourse Master Plan (WCMP) and the Cave Creek/Apache Wash WCMP is largely dependent upon prudent and ongoing management of the watersheds that supply runoff to the WCMP corridors. The ADMP project incorporates existing drainage facilities and current floodplain management and drainage policies into the planning process, and develops regional solutions for the entire Adobe Dam/Desert Hills watershed. The ADMP links management of the watershed to implementation of the WCMPs by making recommendations that support the corridor management tools adopted for the Skunk Creek WCMP and Cave Creek/Apache Wash WCMP corridors.

The major objectives of the ADMP include the following:

- Quantify selected drainage, flooding, and erosion hazards within the project area.
- Alleviate potential flood and erosion damage within the watershed by mitigating the expected increase in runoff due to development and preserving the ability of the primary wash corridors to convey stormwater.
- Couple watershed management with recently adopted Watercourse Master Plan corridor management tools developed for the Skunk Creek and Cave Creek/Apache Wash corridors.
- Develop a plan that area floodplain managers, municipalities, and developers will use as a basis for drainage and watershed regulation, improvements, and design.
- Identify cost-effective, sustainable flood and erosion control solutions for the project area that may be implemented together or individually, based on scheduling, funding, and cost sharing.

3.2 Project Approach

The approach used for the development of alternatives for the Adobe Dam/Desert Hills ADMP is presented graphically in Figure 3.1. The work plan consists of four major components as follows: Problem Identification, Measures (Solutions), Preliminary Alternatives, and **Recommended Alternative**. A brief summary of the specific work tasks comprising these components follows.

ADOBE DAM/DESERT HILLS ADMP ALTERNATIVES DEVELOPMENT PROCESS

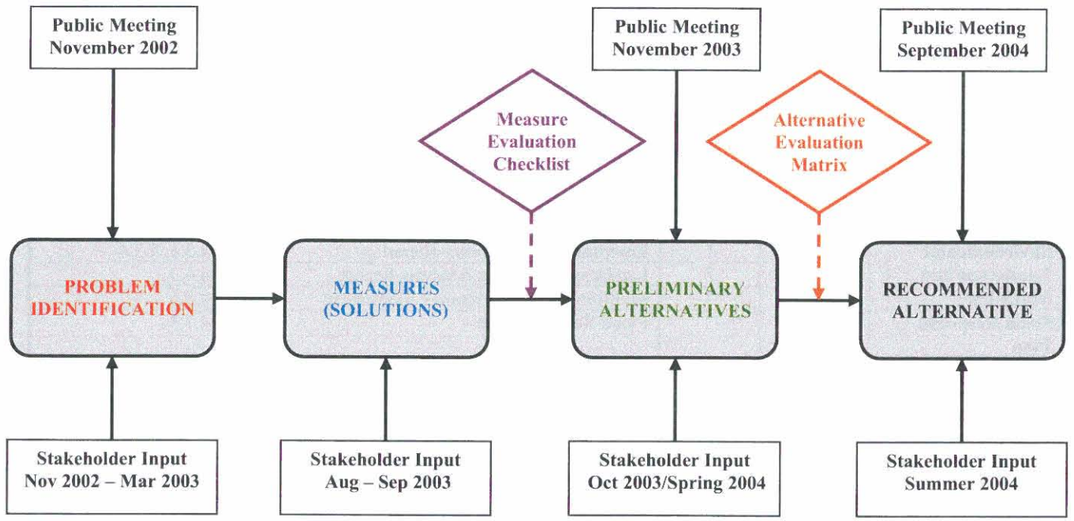


Figure 3.1 Adobe Dam/Desert Hills ADMP Alternatives Development Process Flowchart

Adobe Dam/ Desert Hills ADMP
Alternatives Development Process Description

Problem ID => Measures (Solutions) => Preliminary Alternatives => Recommended Alternative

Problem Identification

1. Data Collection
2. Complete hydrologic, hydraulic, sedimentation, and geomorphic evaluations. Characterize existing and future conditions.
3. Identify Problem Sites - Categorize by geographic region.
4. Stakeholder Meetings – Inform stakeholders about the ADMP. Solicit input regarding flooding, drainage and erosion problems.
5. Public Meeting – Inform public about the ADMP. Solicit input regarding flooding, drainage and erosion problems.

Measures (Solutions)

6. Brainstorm Measures by Site – Create menu of measures. Describe strengths, weaknesses, opportunities, constraints for each measure.
7. Develop Measure Evaluation Checklist – Qualitative sort and selection of candidate measures at each site.
8. Evaluate Measures Using Checklist –Refine menu of measures.
9. Stakeholder Meetings – Input on acceptability/completeness of menu of measures and measures evaluation.

Preliminary Alternatives

10. Alternative Formulation – Combine measures into regional watershed-wide alternatives.
11. Develop Phase I Alternative Evaluation Criteria Matrix – Quantitative sort and selection of candidate alternatives.
12. Evaluate Alternatives Using Criteria Matrix – Decision aid to select preliminary alternatives.
13. Stakeholder Meetings – Input on acceptability/completeness of preliminary alternatives and alternatives evaluation.
14. Public Meeting – Input on acceptability/completeness of preliminary alternatives and alternatives evaluation. Present floodplain delineation studies.
15. Select Preliminary Alternatives for advancement to Phase II evaluation.

Recommended Alternative

16. Phase II Evaluation of Preliminary Alternatives– Determine engineering feasibility and approximate costs. Prepare conceptual design. Consider implementation methods.
17. Develop Phase II Alternative Evaluation Criteria Matrix – Decision aid to select recommended alternatives.
18. Stakeholder Meetings – Input on acceptability/completeness of recommended alternatives and alternatives evaluation.
19. Public Meeting – Input on acceptability/completeness of recommended alternatives and alternatives evaluation.
20. Select Recommended Alternative.
21. Perform Recommended Alternative Analysis.
22. Prepare Recommended Alternative Implementation Plan.

3.3 Project Phasing

The ADMP project was completed in two Phases described as follows:

Phase I consists largely of data collection, existing conditions analyses, formulation of flood protection alternatives, and preliminary analyses of those alternatives. During Phase I, the project team identified drainage problems by evaluating the impacts in the watershed due to development, reviewed the existing and future conditions hydrologic models, revising as necessary, performed hydraulic analyses, evaluated existing floodplain delineations and delineated additional floodplains, conducted sedimentation and geomorphic evaluations, conducted survey work, produced interim development guidelines, and developed preliminary feasible alternatives to be recommended for consideration in Phase II of the project.

Phase II was authorized by the District on June 2. 2003 after feasible, implementable alternatives were identified as a result of the Phase I effort. During Phase II, the project team performed environmental and visual resources assessments, conducted detailed analysis of the proposed alternatives (structural and nonstructural), and formulated and refined the Recommended Alternative. Development guidelines and erosion hazard non-encroachment areas were refined and procedures for implementation of structural and nonstructural plan features were evaluated and recommended.

Site visits, project team meetings, and public and stakeholder information, education, and coordination were integral to both Phases I and II of the ADMP project.

3.4 Project Deliverables

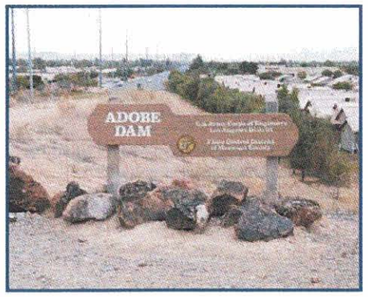


Figure 3.2 Looking south along 35th Avenue from Adobe Dam crest (10-15-02)

Table 3.1 lists the ADMP project deliverables. Note that the deliverables are organized by Part, Volume, and Section as appropriate to the associated work task in the project scope of work. Figure 3.3 presents each of the deliverables listed in Table 3.1 and graphically categorizes the reports by project Phase and Part.

Table 3.1 Adobe Dam/Desert Hills ADMP Deliverables Outline

Part	Volume (Binder)	Section (Tab)	Title	SOW Task Number
1 Data Collection	1	1	Data Collection Report	2.1.7, 2.1.8, 4.1
		2	Stakeholder Involvement Plan	2.8.1, 4.8
		3	Public Involvement Plan	2.9.1, 4.9
2 Survey		4	Project Survey Report	2.3.4
3 Hydrology	1		Desert Hills Area Hydrology TDN	2.5.4, 2.5.9, 2.6.5
	2		Desert Hills Area Hydrology TDN (Appendices: FLO-2D Modeling Documentation)	
	3		Biscuit Flat Area Hydrology TDN	2.5.5, 2.5.9
	4		Lower Skunk Creek Hydrology TDN	2.5.6, 2.5.9
4 FEMA Floodplain Delineation Studies	1		FDS Upper Skunk Creek & Tributaries TDN	2.4.6, 2.4.7, 2.4.8
	2			
	3		Cline Creek Area Approximate FDS TDN	
	4			
	5		Approximate Zone A FDS of Biscuit Flat Area TDN	
	6			
	7		FDS of Portions of Cline Creek Tributary C6, Skunk Creek Tributary 10A & 10B, Upper Skunk Tank Wash, East Fork Desert Lake Wash, and West Fork Apache Wash (Includes 5 Floodway Residences)	2.4.2 CO4
	8			
5 Sedimentation & Geomorphology	1		Sedimentation Engineering and Geomorphology Evaluation	2.7.5
6 Environmental Landscape and Multi-Use	1	1	Environmental Overview Report	4.3.1, 4.3.4
		2	Landscape Character Analysis Report	4.4.3
		3	Multiple-Use Opportunities Assessment	4.5.6
7 Flood Response Plan	1		Flood Response Plan	4.7.3
8 Phase I Alternatives Formulation and Preliminary Analysis	1	11x17 format	Phase I Alternatives Formulation & Preliminary Analysis (Potential Alternatives Submittal)	2.2.8
	2	1	Floodway Structure Risk Assessment	2.5.8, 2.6.4
		2	Floodproofing Evaluation	2.2.4
		3	Interim Development Guidelines	2.2.4, 2.2.5
		4	Roadway Drainage Crossings Hydraulics	2.6.3
8 Phase II Alternatives Formulation	3	11x17 format	Phase II Alternatives Formulation	4.2.7, 4.2.8
	4	binder	Phase II Alternatives Formulation Appendices, Development Guidelines	4.2.9, 4.2.6
9 Adobe Dam/Desert Hills ADMP Report	1	11x17 format	Recommended Alternative Report Implementation Plan	4.6.8, 4.6.9, 4.6.10, 4.11
	2	binder	Recommended Alternative Report Appendices,	4.6.12, 4.8
10 Executive Summary	1	11x17 format	Executive Summary	4.6.11

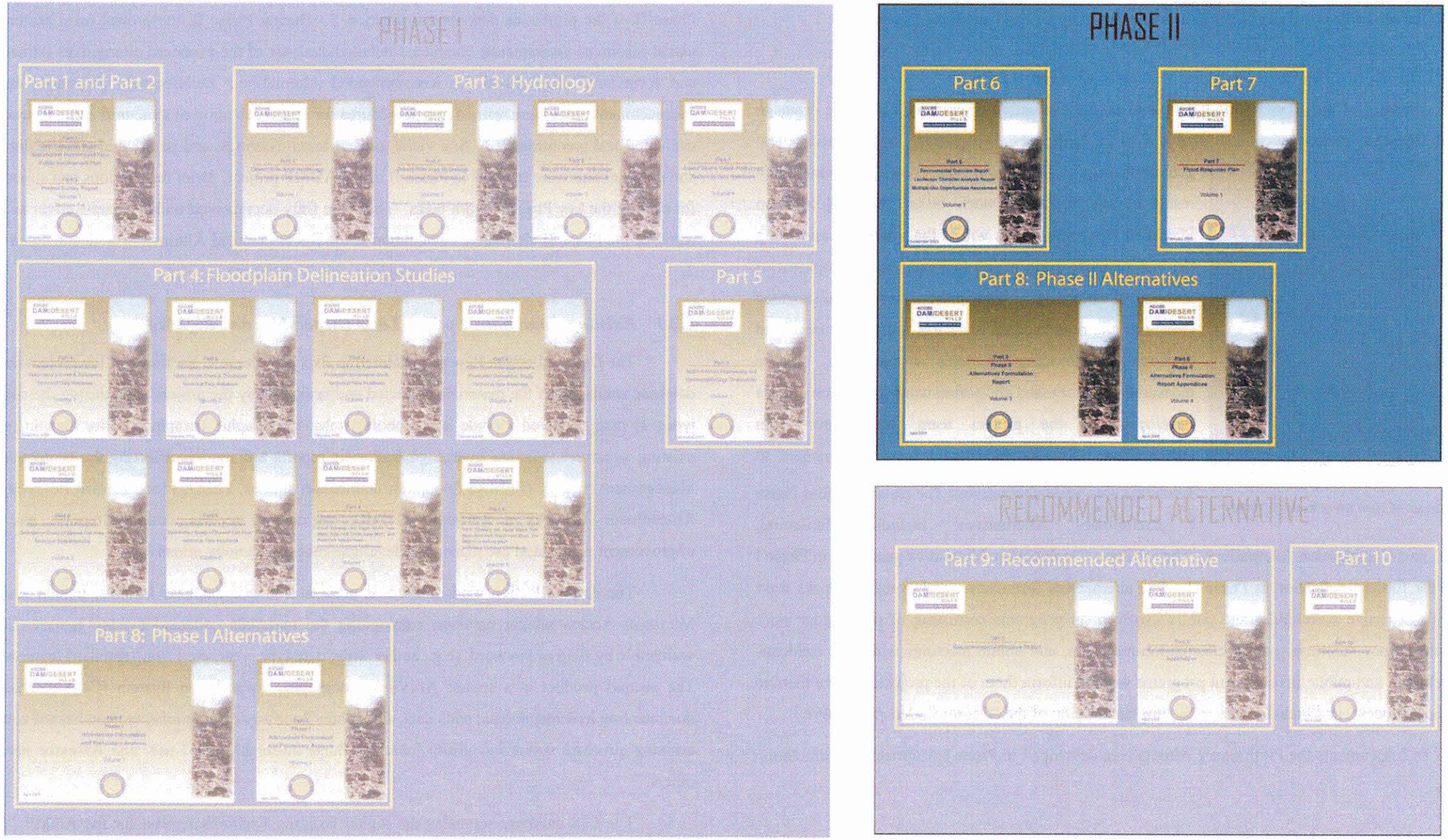


Figure 3.3 Adobe Dam/Desert Hills ADMP Phase II Deliverables Summary

SECTION 4: PROJECT TASK DESCRIPTIONS

This section briefly summarizes the work tasks of the ADMP project. For more detailed information about any of these tasks, refer to the associated project deliverable as listed in Table 3.1 and shown in Figure 3.3.

4.1 Phase I Tasks

The work plan for Phase I of the ADMP initially focused on the evaluation of existing and future drainage and flooding conditions through various technical analyses (i.e., hydrology, hydraulics, sedimentation, and geomorphology). Based upon the knowledge gained as a result of the technical work tasks, the project team identified 16 problem sites within the watershed and along the watercourses upon which to focus the development of alternative solutions. The project team brainstormed structural and nonstructural measures to mitigate identified drainage and flooding problems at each site. These measures were screened and sorted using evaluation criteria developed by the project team with input from stakeholders. Site-specific measures were combined to formulate area-wide alternatives. The result was four Phase I Preliminary Alternatives; including Structural, Nonstructural, No Action, and Combination Alternatives. The resultant Combination Alternative generated in Phase I of the ADMP advanced for further evaluation at Phase II. The alternatives formulation and evaluation tasks were performed in parallel with extensive stakeholder and public involvement programs consisting of stakeholder work group meetings, individual agency meetings, public information materials, and public meetings with area residents. The purposes of the stakeholder and public involvement programs were to inform them of the project, involve them in the alternatives development process, and include them in the implementation of the Recommended Alternative.

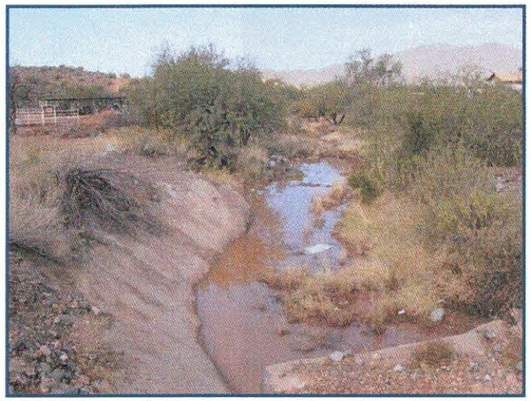


Figure 4.1 Rodger Creek downstream of New River Road (9-20-04)

Part 8, Volume 1 & 2 documents the Preliminary Alternatives developed in Phase I Alternatives Formulation and Preliminary Analysis.

4.2 Phase II Tasks

Based on the Phase I work tasks briefly described in Section 4.1 and fully documented under separate cover as listed in Table 3.1, the Phase I Combination Alternative was recommended for further evaluation and refinement in Phase II of the project as described in Section 5. During Phase II, the project team performed environmental and visual resources assessments, conducted detailed analysis of the proposed alternatives (structural and nonstructural), and formulated and refined the Recommended Alternative. Development guidelines and erosion hazard non-encroachment areas were refined and procedures for implementation of structural and nonstructural plan features were evaluated and recommended. Site visits, project team meetings, and public and stakeholder information, education, and coordination were integral to Phase II of the ADMP project. Brief descriptions and summaries of findings follow for each of the key Phase II work tasks. These are fully documented under separate cover as listed in Table 3.1. The result of the Phase II alternatives evaluation is the Recommended Alternative as documented in Part 9, Volumes 1 & 2.

4.2.1 Existing Conditions Update, Land Ownership, and Right-of-Way

The Data Collection Report, presented in Part 1, Volume 1, Section 1 of the project deliverables, describes the database catalogue of the materials collected and reviewed by the project team during the course of the ADMP. The types of data collected include aerial photographs, topographic mapping, utility location maps, as-built plans for existing structures, existing hydrologic/hydraulic reports and models affecting the project area, Federal Emergency Management Agency (FEMA) floodplain delineation studies, FEMA Flood Hazard Boundary Maps, Letters of Map Amendment (LOMA) or Revision (LOMR), engineering reports, drainage reports, site plans, future drainage improvement plans, land use plans, and development plans, among others.

The data collection work product is presented in two database formats; tabular and spatial. The first is a Microsoft Access tabular database cataloguing the materials collected for the project. The tabular database is searchable by field or keyword, (e.g., author, title, data type, year, etc.) using standard features of the Access software. The second product is a spatial ArcView Geographic Information System (GIS) database with multiple layers documenting hydrologic data, soils data, floodplain/floodway delineations, erosion hazard zone delineations, roadway crossing structure inventory, utility locations, land ownership, land use, and Assessor parcel information, among others.

The GIS database serves as the digital Existing Facilities Exhibit for the ADMP. The team used the GIS database to display key drainage features, to evaluate existing conditions, and to identify areas impacted as a result of implementation of the alternatives. The project team collected and reviewed these data from the District and multiple

other sources, including stakeholder agencies and the public. Where data were lacking or unavailable, the team conducted site visits and field surveys to supplement existing data and/or to collect new information.

During Phase II, the project team updated and refined the Existing Facilities Exhibit to reflect new information, as appropriate. Database updates focused on the following features:

- Right-of-way (ROW) information and identification of ROW and easement requirements for the proposed alternatives;
- Land ownership for the properties potentially impacted by the proposed alternatives; and
- Major existing utilities impacted by the proposed structural alternatives.

4.2.2 Alternatives Analysis

The Phase II work tasks were performed to evaluate the engineering feasibility of the Combination Alternative recommended at the conclusion of Phase I of the project. The Combination Alternative comprised structural and nonstructural measures identified for 16 sites within the project area, plus the watershed-wide alternatives (See Part 8, Volumes 1 & 2 for details). The 16 sites were labeled using an alphanumeric descriptor consisting of the name of the subarea in which the site was located followed by chronological project site number. For example, Site DH11 is located in Desert Hills (DH) and is 11th in chronological order. Figure 4.2 presents a key map showing the subareas and the alternatives sites. During Phase II, conceptual design plans of project features were prepared considering sound engineering design along with the environmental compatibility and landscape aesthetics of the major project components. The project team developed evaluation criteria to sort the Phase II alternatives and select the components comprising the Recommended Alternative. Refer to Section 5 of this report for full presentation of the alternative formulation and evaluation process and the resultant Recommended Alternative. The Recommended Alternative and Implementation Plan are documented in Part 9, Volumes 1 & 2.

The following sections refer to this numbering system, PSC1, PNC3, etc., until you get to Section 5. In phase II, because of difficulties in keeping the sites straight, the numbering was changed to site 1, site 2, etc. Table 5.1 contains a column correlating the old numbering system to the new numbering system.

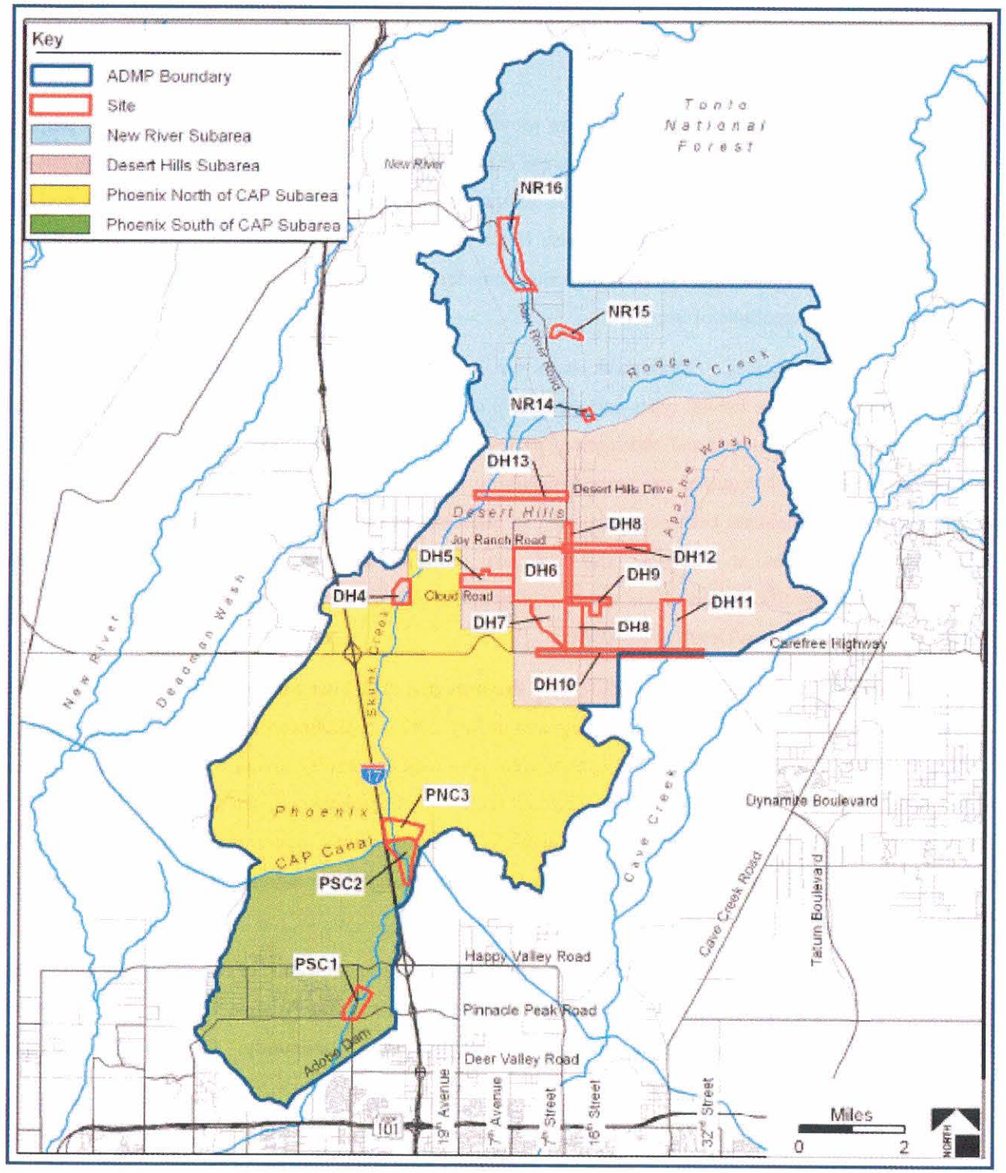


Figure 4.2 Subarea and Alternatives Site Map

4.2.3 Environmental Overview

The Environmental Overview Report is provided in Part 6, Volume 1, Section 1. The purpose of the environmental overview was to collect and provide data to assist the project team in evaluating the environmental issues and impacts associated with each Phase II alternative measure. The environmental overview determined the potential impacts of each of the proposed Phase II alternatives on the identified ecological resources, hazardous materials, and cultural resources. The environmental considerations were compared across the Phase II alternatives to evaluate the relative magnitude of impact.

Ecological Resources – Ecological issues are important to consider in the planning process for several reasons. Documenting the habitat types and vegetative communities can indicate the potential for protected species (e.g., federally listed threatened and endangered species) to occupy the study area. Often, obtaining certain types of environmental permits is required for ground-disturbing projects, so that trying to avoid or minimize impacts to unique and sensitive habitats becomes essential. In addition, one of the project's objectives may include habitat enhancement, restoration, or creation. The ecological resources assessment focused on natural vegetation and wildlife, as well as specific protected and sensitive plant and animal species, at the 16 separate structural measure sites identified in the Adobe Dam/Desert Hills ADMP.

Natural vegetation, observed wildlife, and the presence of habitat for sensitive species were identified by conducting a reconnaissance survey of the study area in July 2003. A photo record of the survey was obtained while visiting the sites. Large-scale aerial photographs were also used to identify natural vegetation communities, study-area watercourses, and general land use on a regional scale. A comprehensive plant and wildlife survey was beyond the scope of the ADMP. However, lists of potentially occurring plants, mammals, birds, and herpetofauna were collected from the existing literature using distribution maps and habitat requirements of various Arizona flora and fauna.

Vegetation Communities – The study area is located at the transition zone of two vegetative communities: the Lower Colorado River Valley (LCRV) (creosotebush-bursage series) and Arizona Upland (AU) (paloverde-cacti-mixed scrub series) subdivisions of the Sonoran Desertscrub Biotic Community. Figure 4.3 shows examples of LCRV and AU vegetative communities.

Figure 4.3 Examples of LCRV (left) and AU (right) vegetative communities (7-03)

- The LCRV Subdivision in the ADMP study area includes the areas of low relief, where the vegetative structure is open and simple. The dominant plant species is creosotebush, with the occasional mesquite, paloverde, ironwood, saguaro, or clump of desert broom visible in the upland landscape. The Phoenix/CAP Canal and Desert Hills subareas of the study area generally support vegetation of the LCRV Subdivision.

- The AU Subdivision predominates in the New River subarea and is marked by a slightly higher elevation, rolling terrain, and subsequently more lush vegetation. Numbers of mesquite, paloverde, and saguaro are higher and numerous species of cholla, prickly pear, and other cacti are present among the dense undergrowth of desert shrubs in the AU subdivision.

No perennial watercourses or standing water from springs are present in the study area, thus true riparian zones are absent. However, noticeable xeroriparian vegetation can be found lining even the small washes in both vegetative communities. Xeroriparian vegetation is an important component to desert ecosystems because they usually support a more diverse wildlife community and provide an important movement corridor, together with the wash bed itself, for migrating birds and other wildlife with large home ranges. Human disturbance and livestock grazing throughout the ADMP study area has altered or completely removed the native vegetation of these three community types in many areas. Figure 4.4 shows examples of xeroriparian habitat and cleared areas.

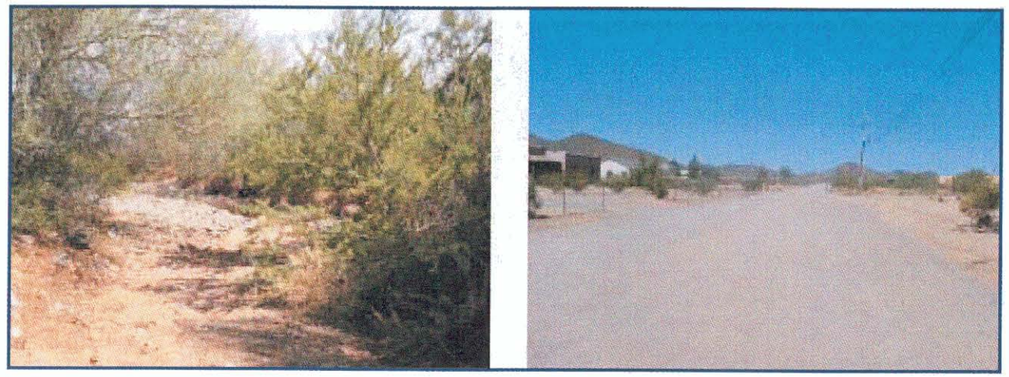


Figure 4.4 Examples of xeroriparian habitiat (left) and an area of cleared native vegetation (right) (7-03)

An evaluation was made at each of the 16 structural measure sites as to whether the vegetative community(ies) present there are "disturbed" or "undisturbed" by human activities. Areas highly disturbed by human activity were classified as "previously cleared". Disturbed areas are areas that have key elements of the vegetative community present, but there are signs of grazing, human recreation, dumping, and/or minor clearing. Undisturbed is defined as areas of a vegetative community that have a full set of component plants, where there is little to no clearing of vegetation for built structures, and there is little to no evidence of grazing by livestock. Previously cleared areas have little to no natural vegetation and are usually areas of current human development, including residential areas and roads; some introduced landscaping may be present. Special ecological features, including cliff habitats, stock tanks, and other fresh water sources were noted for each of the 16 sites.

The work product for the vegetation communities evaluation at each of the 16 structural measure sites is three-fold and includes the following: 1) spatial representation of the extent of the identified vegetation communities; 2) a site-specific narrative description of the ecological resources; and 3) ground photographs showing key ecological features. Examples of these work products are provided below for Site DH11 Apache Wash/24th Street in the Desert Hills area. Similar maps, narrative descriptions, and illustrative ground photos for each of the 16 structural measure sites are provided in Part 6, Volume 1, Section 1 Environmental Overview Report. An excerpt from the ecological resource evaluation discussion for Site DH11 follows. Figure 4.5 is a ground photo of a stock tank located at this site. Figure 4.6 provides an example of the vegetative communities evaluation for Site DH11 in the Desert Hills area. These ecological resource factors are part of the Phase II evaluation criteria used to select the Recommended Alternative as discussed in Section 5 herein.

"Apache Wash and 24th Street are on a similar North-South alignment at DH11, resulting in numerous dip crossings on 24th Street where flows cross the roadway. Aside from disturbed roadway areas, the Apache Wash has intact xeroriparian vegetation. The western and southeastern upland areas of DH11 are flat, open, and dominated by creosotebush; the northeast upland area has a dense stand of paloverde trees and numerous individuals of several species of Opuntia are present. Five stock tanks are present at DH11 in the uplands on each side of the wash. The tanks are normally dry during the summer months, though at least one had begun to fill with standing water after one brief monsoon shower, as observed during the field survey. These remote stock tanks are special ecological features at this site since they provide shade in the summer and standing fresh water during wetter periods. Local wildlife probably rely on the tanks for water; and some migrating birds may use the tanks as temporary layovers."

(Excerpt from Adobe Dam/ Desert Hills ADMP Part 6, Volume 1, Section 1 Environmental Overview Report, p. 32)

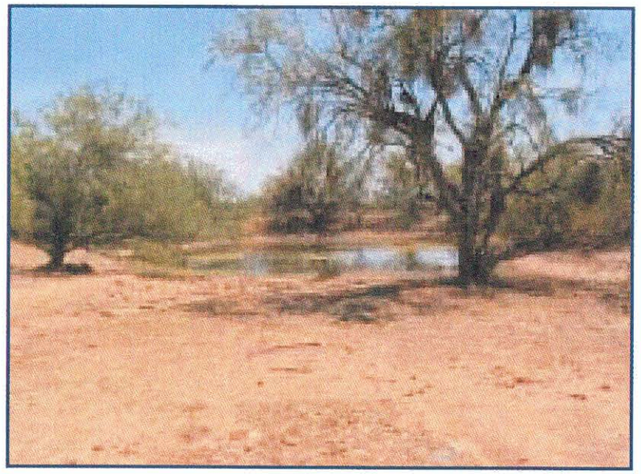


Figure 4.5 Stock tank with standing water located in the vicinity of Site DH11 (7-03)

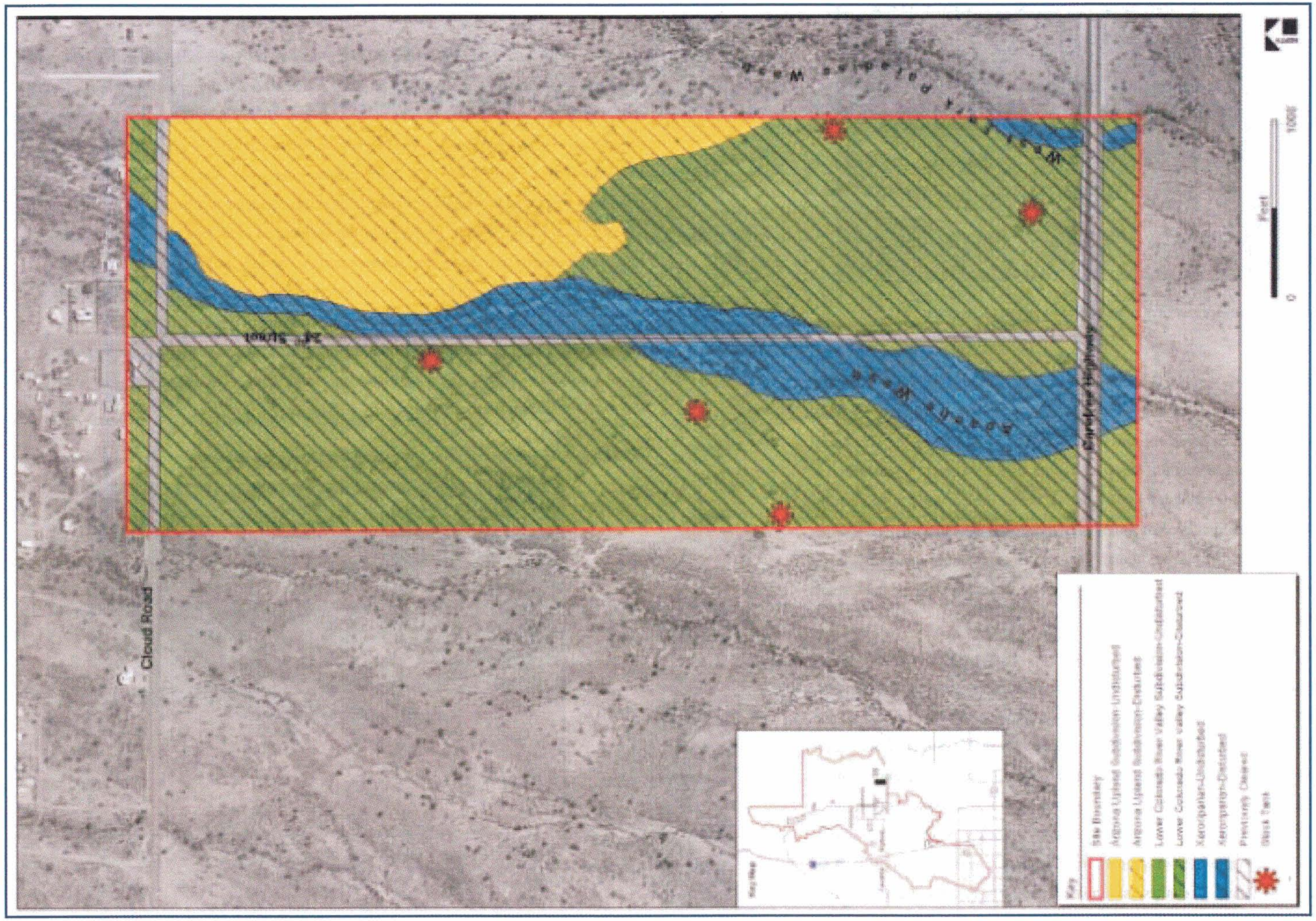


Figure 4.6 Site DH11 Vegetation Communities

Habitat Quality – Using a "disturbed" or "undisturbed" designation of the vegetation at each alternative site and taking into account other ecological factors such as habitat connectivity, food and water availability, and proximity of human activity, a qualitative ecological evaluation was made for each of the sites, as follows:

- High Habitat Quality – A determination of high habitat quality was given to undisturbed areas of vegetation, especially xeroriparian vegetation along washes. The presence of dense vegetation suggests plentiful food and water sources. Large washes that allow the movement of wildlife across long distances across the landscape receive a high rating.
- Medium Habitat Quality – Medium areas can be either disturbed or undisturbed and provide only moderate cover, food, and water. Such areas' values are enhanced by the presence of adjacent high-value habitat. Smaller washes and degraded larger washes merit a medium rating since they are still an attractant to wildlife looking to avoid human contact as they move across the landscape.
- Low Habitat Quality – Disturbed areas that have scant cover, food, and water availability are rated low. Areas that have been previously cleared or contain built structures, natural areas with moderate to severe degradation (especially those next to cleared areas), or areas of natural vegetation greatly isolated from other areas of natural vegetation are all rated low in habitat quality.

The extent and level of habitat quality was spatially represented on maps for each of the 16 structural measure sites (Part 6, Volume 1, Section 1). Habitat quality was another element of the evaluation criteria used to sort the Phase II alternatives. An example of the habitat quality map for Site DH11 is shown in Figure 4.8. Figure 4.9 shows a small cliff habitat along a bend in Sonoran Wash downstream of the CAP aqueduct. Sonoran desert tortoise frequent these types of habitat features, but the isolation of this particular site may prohibit their presence here.

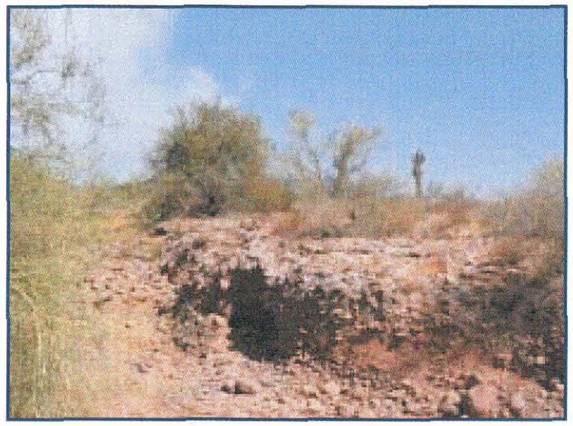


Figure 4.7 Sonoran Wash cliff habitat at Site PSC2 (7-03)

Wildlife - The number of wildlife species present in a particular area is generally dependent on the extent of removal of native vegetation and the intensity of human disturbance. Rural residential areas with significant amounts of native vegetation will support many of the species normally present in the undisturbed vegetative communities. High-density residential areas and commercial and industrial properties will support very few species.

Mammals likely to be seen in the study area include desert cottontail, coyote, javelina, and mule deer. (Only the desert cottontail was seen during the field survey.) Several species of bats could forage for nectar and/or insects throughout the study area. Most of the wildlife observed during the reconnaissance survey were birds, which is expected since most birds are active and visible during daylight hours and are the most likely group of vertebrates to be encountered during a brief windshield survey. Several bird species are common around human habitation, especially on properties where livestock is present due to the presence of fresh food and water. Such properties are very common throughout the Desert Hills and New River subareas of the study area. House sparrow, house finch, rock dove, mourning dove, European starling, and great-tailed grackle were most commonly seen in human-disturbed areas. Species such as curve-billed thrasher, cactus wren, Gambel's quail, Gila woodpecker, verdin, and northern mockingbird were more readily observed in xeroriparian vegetation in the study area. One roadrunner and one greathorned owl were also spotted in xeroriparian vegetation. Amphibians, reptiles, or fish were not observed during the reconnaissance survey; however, a detailed search was not conducted in suitable habitats. Observations of specific wildlife seen on the reconnaissance survey are mentioned in the site-specific descriptions provided in Environmental Overview Report (Part 6, Volume 1, Section 1). Other wildlife species that have the potential to be found in the overall study area are listed in Appendices A through D of that same report.

Threatened, Endangered, and Sensitive Species – A list of threatened, endangered, proposed, or candidate species for Maricopa County was obtained from the US Fish and Wildlife Service (USFWS). Also, a query was requested from the Arizona Game and Fish Department's (AGFD) Heritage Data Management System, which includes sensitive species that have the potential to occur within 3 miles of the overall ADMP study boundary. AGFD lists species whose occurrence in Arizona is or may become in jeopardy.

Of the threatened and endangered species, only the cactus ferruginous pygmy-owl (CFPO) has suitable habitat in the study area. While mature riparian forests are absent, dense xeroriparian habitat is present along many of the washes, and upland saguaros with suitable nesting cavities are often found nearby. With the exception of PSC1, the other structural measure sites are outside the Phoenix Urban Exclusion Area and are all in Survey Zone 3 for the pygmy-owl, defined by the USFWS as "areas within the historic range of the pygmy-owl with a low potential of occupancy". While the nearest known populations of CFPO are in the greater Tucson area, presence/absence survey

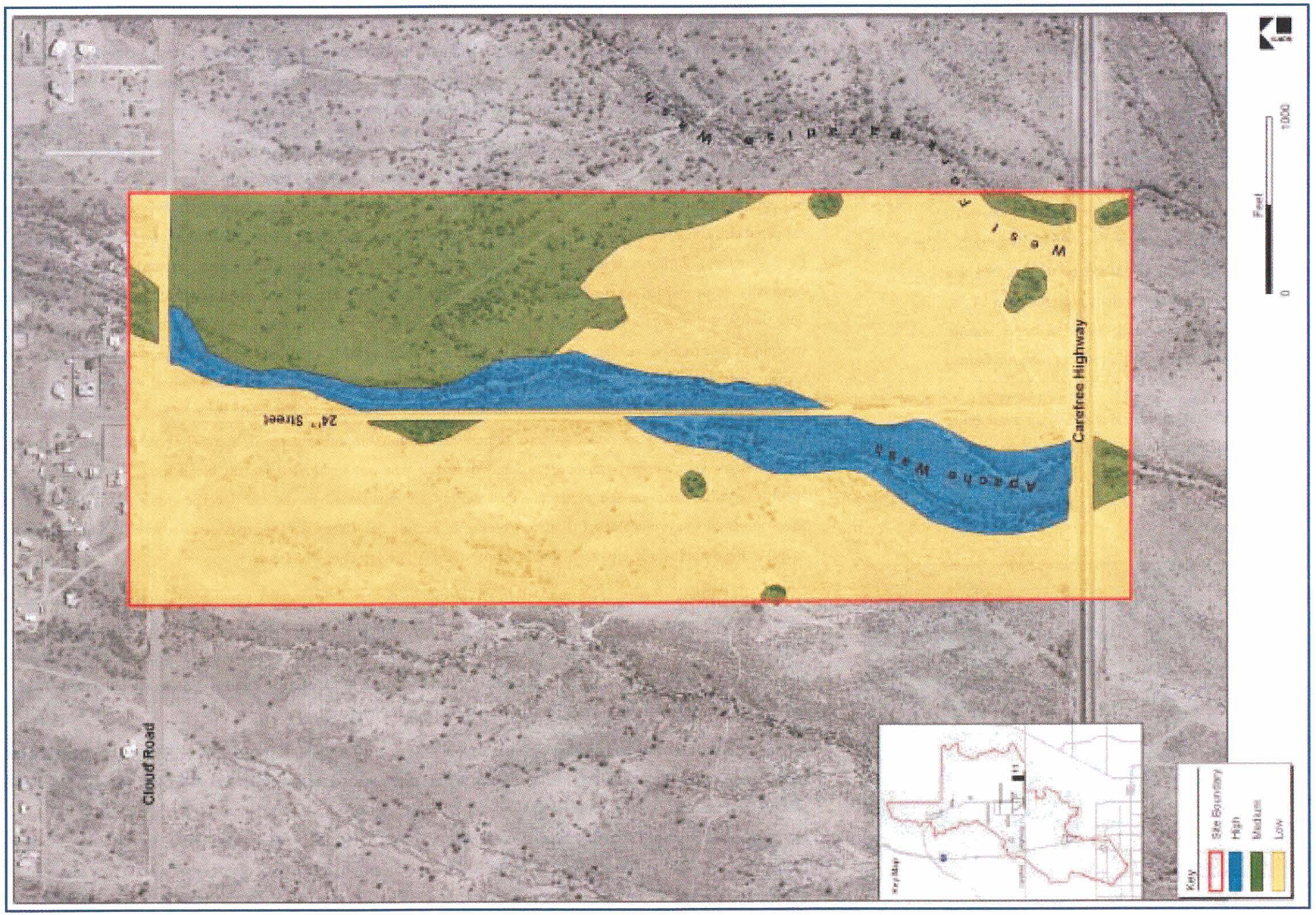


Figure 4.8 Site DH11 Habitat Quality Map

may be required in areas of suitable habitat to ensure no individuals are present at sites of future ground-disturbing activities. Food plants for the lesser long-nosed bat, namely the saguaro, are present at some of the sites, especially in the New River subarea. However, individuals of this species are very rare this far north in its range, and they would utilize food plants in the study area only during the spring bloom. It is unlikely that removal of saguaro during individual projects in the study area would impact this species, and no mitigation for the bat would be necessary during design/construction.

Of the special status species, suitable habitat for the Sonoran desert tortoise is present (riverbanks, washes dunes, and rocky slopes), and it is likely to occur at some of the structural measure sites, especially those near undisturbed upland areas and in washes with small cliffs present on eroded banks. Site-specific issues concerning threatened, endangered, and sensitive species and related suitable habitat are mentioned in the site-specific evaluations provided in Part 6, Volume 1, Section 1.

Hazardous Materials Concerns – The purpose of the hazardous materials investigation is to identify concerns at each of the structural measure sites (summarized by subarea) so that future planning effort might avoid impacting areas that may be potentially expensive to remediate or to ensure appropriate remediation efforts are undertaken before future ground-disturbing activities occur. Hazardous materials are chemical substances, which if released or misused can pose a threat to human health or the environment. These chemicals are used in industry, agriculture, medicine, research, and consumer products. Hazardous materials can be explosive, flammable, and/or combustible substances; poisons; and radioactive materials. These chemicals are regulated by the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). RCRA and CERCLA are implemented and enforced by the US Environmental Protection Agency (EPA).

In order to identify potential hazardous materials concerns in the study area, a review of federal and state government records was completed and documented in an Area Study Report produced by Environmental Data Resources, Inc. (EDR) in July 2003. All 16 of the structural measure sites were combined together to form a "target property". The search for hazardous materials included this target property and a buffer zone around the entire area. A comprehensive list of all of the various databases queried for hazardous materials concerns along with the different search radii used for each query are listed in the Part 6, Volume 1, Section 1 Environmental Overview Report. The database list and search radii meet the search requirements of the American Society for Testing and Materials Standard Practice for Environmental Site Assessments. A summary of the findings categorized by subarea follows. Figure 4.10 illustrates the spatial distribution of the identified hazardous materials concerns.

Phoenix South of CAP – Numerous hazardous materials concerns were discovered from the records check at and near the Skunk Creek Landfill. The landfill itself is a registered municipal solid waste landfill. Three hazardous materials spills have been reported there (oil, perchloroethylene, and an oil fire) but have been remediated. Two inactive underground storage tanks were reported at the landfill, and the landfill is a known treatment, storage, or disposal facility (TSDF). Another privately-owned TSDF is present in the light-industrial complex on the southwest corner of PSC1; it is classified as a "conditionally exempt small-quantity generator." Drywell shafts or holes, whose depths are greater than their widths and are designed and constructed specifically for the disposal of stormwater, are bored, drilled, or driven. Drywells rely on gravity to drain liquid wastes into the ground; their construction provides minimal to no protection against potential ground water contamination. A drywell is also present in one of the parking lots of that complex. If impacted by the project, Arizona Department of Environmental Quality's (ADEQ's) Water Permits Section, Industrial & Drywell Unit should be contacted to determine if further work would be required for these drywells.

The Circle K at 35th Avenue and Happy Valley Road has three active underground storage tanks; a convenience store has eight active underground tanks at 36th Avenue and Pinnacle Peak Road. Another inactive underground storage tank is reported for another location nearby. All of these tanks are outside the PSC1 boundaries.

Finally, in areas of Skunk Creek (especially in the nonchannelized segment between the landfill to the east and the industrial/residential complex to the west), extensive wildcat dumping was discovered on a site visit to the area. Numerous old appliances, abandoned vehicles, and wooden pallets (along with other trash) were strewn about the various dirt roads bisecting the wash vegetation of the creek. (See Figure 4.9).

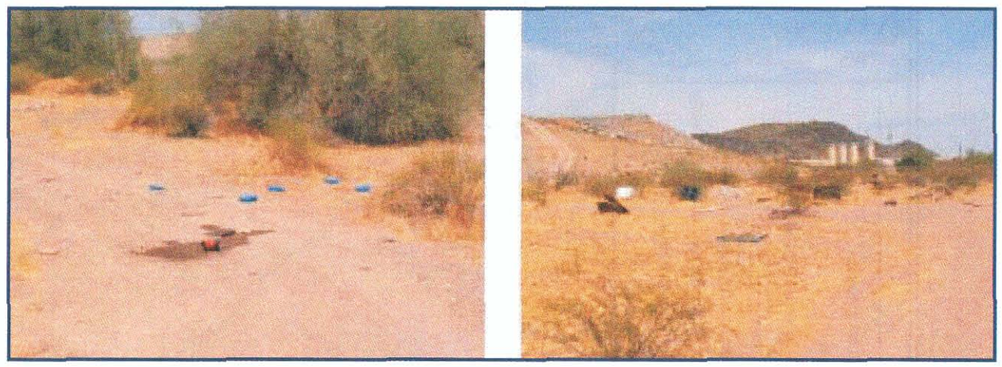


Figure 4.9 Examples of illegal dumping at Site PSC1

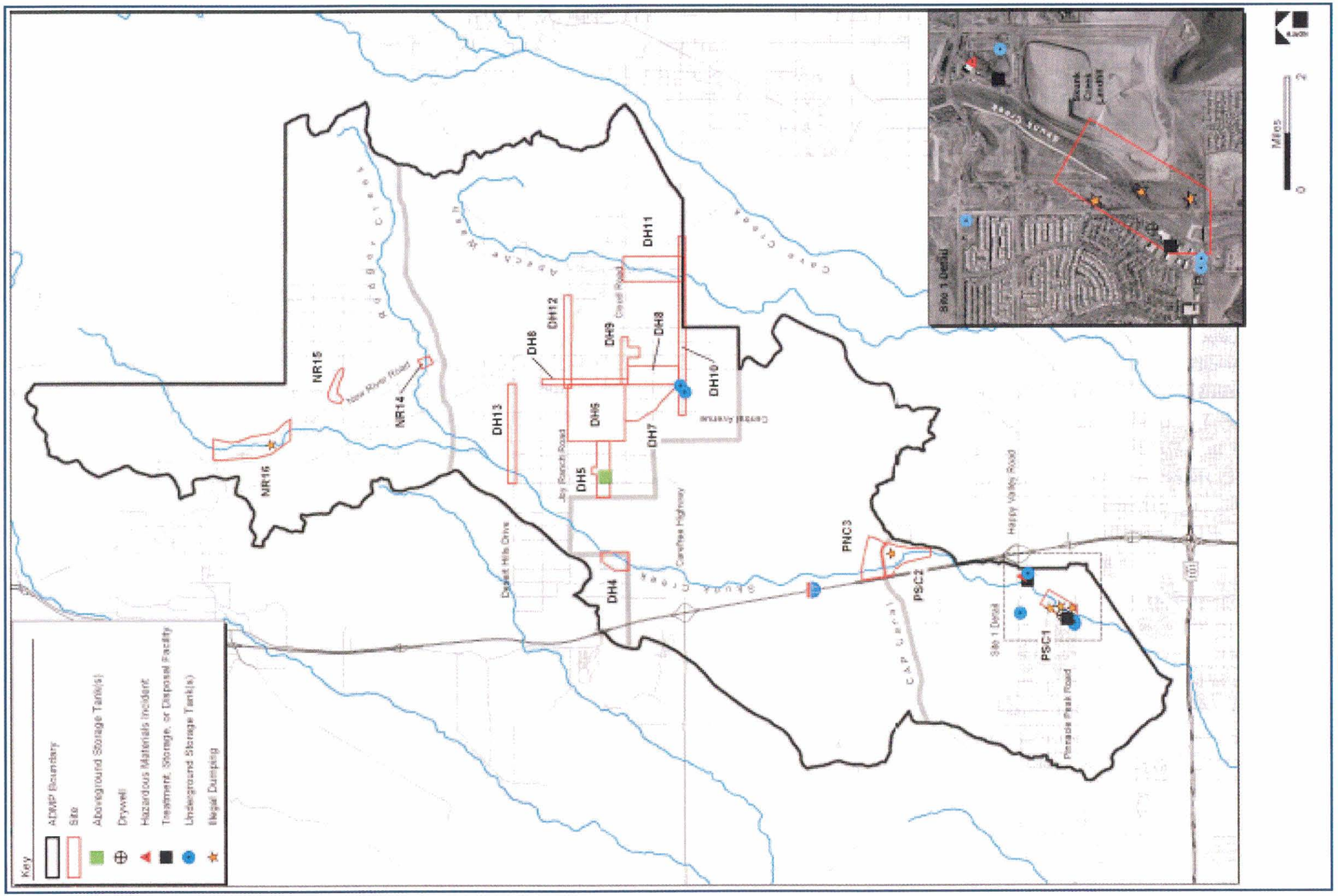


Figure 4.10 Hazardous Materials Concerns

Phoenix North of CAP – No hazardous materials concerns were discovered from the records check. During a sight reconnaissance of the PNC3, no hazardous materials concerns were discovered in the rural housing developments, in the undeveloped desert areas, or along the washes. The USBR fencing at the CAP canal precludes the dumping of trash at PNC3.

Desert Hills –Skunk Creek at DH4 was clear of debris; one aboveground storage tank was reported at the K/B Ostrich Ranch at the western end of DH5. Two convenience stores have active underground storage tanks at DH10. 4 Sons Food Stores has four tanks just east of 3rd Street and south of the Carefree Highway; Unocal Desert Express has two tanks at the northwest corner of Carefree Highway and 7th Street. During a sight reconnaissance of the various sites, no hazardous materials concerns were discovered in the rural housing developments, in the undeveloped desert areas, or along the washes.

New River – No hazardous materials concerns were discovered from the records check. During a sight reconnaissance of the three sites, small areas of wildcat dumping were discovered at NR16. Old appliances and other household debris were scattered around the dirt roads crisscrossing near Skunk Creek downstream of the bridge at New River Road.

Cultural Resources – The District contracted with Scientific Archeological Services to prepare an assessment of all archeological sites known to occur in or near the vicinity of the 16 structural measure sites. In December 2003, Scientific Archeological Services produced a report entitled *The Adobe Dam – Desert Hills ADMP Archeological Assessment Project of Northern Maricopa County, Arizona.* The report identifies the extent to which each of the sites has been previously surveyed for cultural resources and details all the previously recorded sites that have been recorded in their vicinities. Archival research was the exclusive means for obtaining cultural resource data, and it involved both literature searches and site record checks. Thirty-three separate cultural resource investigations have been completed among all the structural measure sites dating from 1893 to 2001; 25 of which consisted of professional archeological field surveys that covered approximately 28 percent of the study area.

Fifteen archeological sites have been previously recorded at or near the 16 structural measure sites (see Table 4.1). Only five of them have been formally recorded by archeologists, however; the other ten are informal sites that were mapped by Government Land Office surveyors. Four of the 15 sites date to the prehistoric past and represent two activity patterns: habitation and natural resource exploitation. They are mainly Hohokam Indian sites, but one may date to the earlier Archaic period. The other 11 sites are historic and represent two cultural themes: vehicle transportation and residential living. All but one of them date to the Arizona Statehood phase of 1912–1953. The other dates to the Territorial times of 1863–1912.

Table 4.1 Summary of Previously Identified Cultural Resources in the Study Area

Site Type	Historic (H)/ Prehistoric (P) in Age	Associated Sites
Dirt Road	H	PSC2, PNC3
Dirt Road	H	DH4
Dirt Road	H	DH6
Residence	H	DH6
Residence	H	DH6
Dirt Road	H	DH6, DH7
Dirt Road	H	DH6, DH13
Lithic scatter	P	DH8
Dirt Road	H	DH9, DH12
Farmstead	P	DH11
Dirt Road	H	DH12
Dirt Road	H	NR14
Camp	P	NR14
Artifact scatter	P	NR15
Dirt Road	H	NR16

A summary of the cultural resources assessment findings categorized by subarea follows:

Phoenix South of CAP and Phoenix North of CAP – A couple of surveys have been done in the vicinity of PSC1, however, PSC1 has not been surveyed for cultural resources. A large portion of PSC2 and all of PNC3 has been surveyed. The historic Prescott- Phoenix Road has been recorded in the vicinities of these sites (Table 4.1).

Desert Hills – All of DH4 has been surveyed for cultural resources. A historic road crosses the site somewhere between Cloud Road and Carefree Highway (Table 4.1). DH5 has been completely surveyed, but only a third of DH6 has been surveyed. However, two historic residences have been recorded at DH6 along with three dirt roads, two of which extend to DH7 and DH13 to the south and north, respectively. Only a small corridor along a segment of 7th Street has been surveyed at DH7. The 7th Street corridor along DH8 has not been surveyed. One prehistoric lithic scatter has been noted at DH8. None of DH9 has been surveyed, though a historic dirt road connects DH9 to the area around DH12 to the north. The corridor along Carefree Highway has been surveyed at DH10, though the site boundary for the cultural study is much smaller than the DH10 boundary used for the rest of the environmental investigations. Carefree Highway and the major utility line corridor cutting across DH11 are the only

parts of that site that have been surveyed for cultural resources; the remains of a prehistoric farmstead are located there. The northwest and southeast corners of DH12 have been surveyed; another historic dirt road has been recorded bisecting the site. About a third of DH13 has survey coverage; no sites have been previously described there.

New River – None of Site NR14 has been surveyed for cultural resources, though a historic dirt road and a prehistoric camp have been recorded in the vicinity (Table 4.1). Most of NR15 has been surveyed, except for the area of Cline Creek north of Circle Mountain Road. A prehistoric artifact scatter is located nearby near New River Road. Only a corridor around some of New River Road at Site NR16 has been surveyed. A historic dirt road cuts across the site in its northern half.

Conclusions and Recommendations – Natural habitat in the study area consists of LCRV (creosotebush-bursage series) and AU (paloverde-cacti-mixed scrub series) subdivisions of the Sonoran Desertscrub biotic community. While true riparian zones are absent, noticeable xeroriparian vegetation can be found lining even the small washes in both vegetative communities.. Generally, this xeroriparian vegetation is categorized as high- and medium-quality habitat.

Two threatened and endangered species are of concern in the study area: the CFPO has suitable habitat in the study area, while food plants for the lesser long-nosed bat, namely the saguaro, are present at some of the sites, especially in the New River subarea. Of the special status species, suitable habitat for the Sonoran desert tortoise is present (riverbanks, washes, dunes, and rocky slopes), and it is likely to occur at some of the structural measure sites, especially those near undisturbed upland areas and in washes with small cliffs present on eroded banks.

During future construction at any of the structural measure sites, washes and related xeroriparian vegetation should be avoided, when possible. This will aid in minimizing disturbance to habitat that is generally categorized as high and medium quality and will help in maintaining habitat and corridor connectivity in areas where it is still intact. When impacts to washes and vegetation are necessary, revegetating with an appropriate density and diversity of native vegetation will help restore or enhance habitat quality.

Site PSC1 has several hazardous materials concerns in the vicinity, including a drywell, a previously remediated hazardous materials incident, two TSDFs, four locations of USTs, and scattered illegal dumping. Throughout all of the other structural measure sites, two locations of USTs, one aboveground storage tank, and several sites of illegal dumping are present. Known hazardous materials sites should be avoided by future construction. If they cannot be avoided or if new hazardous materials sites are discovered during future projects, steps should be undertaken to remediate the concerns before continuing with ground-disturbing activities.

In December 2003, Scientific Archeological Services produced a report entitled *The Adobe Dam – Desert Hills ADMP Archeological Assessment Project of Northern Maricopa County, Arizona.* Fifteen archeological sites have been previously recorded at or near the 16 structural measure sites (five of them formally recorded by archeologists, the other 10 informal sites mapped by Government Land Office surveyors). Previously identified cultural resources should be avoided by future construction. If they cannot be avoided, testing and data recovery activities may be necessary at the sites. If new cultural resources, including human remains, are discovered during project activities, work should cease and the appropriate agencies should be contacted to determine the significance of the cultural resources.

The following specific recommendations are listed to remind future planners, designers, and contractors of the possible permits, surveys, and other environmental clearances that may be required for individual alternatives chosen for implementation at specific structural measure sites:

- Presence/absence surveys for CFPO may be necessary for up to 2 years at all structural measure sites that are located within CFPO Survey Zone 3 and outside the Phoenix Urban Exclusion Area (all but Site PSC1) if ground-disturbing activities and/or noise are determined to affect nearby habitat components of the CFPO.
- If Sonoran desert tortoises are encountered during construction at any of the structural measure sites, the contractor should follow the guidelines for handling and removing the tortoises as provided in Appendix H of the Environmental Overview Report (Part 6, Volume 1, Section 1).
- AGFD should be contacted to obtain updated and current information on special status species during the design and environmental clearance stages.
- If protected native plants are impacted by construction activities, a permit should be obtained from the Arizona Department of Agriculture prior to clearing and grubbing activities. The permit may include salvaging provisions.
- Surveys for invasive species may be necessary at individual project sites, and mitigation such as reseeding with native species may be required for ground that is disturbed.
- A Phase I Environmental Site Assessment for hazardous materials should be conducted prior to possible property acquisition during the design phase of any of the individual alternatives, and further hazardous materials investigation may be necessary for projects occurring near known concerns or if hazardous materials are discovered during ground-disturbing activities.
- For those areas not previously surveyed for cultural resources, a Class III (pedestrian) archeological survey

should be conducted prior to ground-disturbing activities. All county, state, and federal archeological compliance guidelines should be followed during the design and implementation of future activities. New sites should be recorded and evaluated for possible inclusion in the National Register of Historic Places. While avoidance of known sites is preferred, unavoidable impacts might be mitigated by testing and data recovery of those sites.

- The appropriate local floodplain manager should be involved on any projects that impact the 100-year floodplain, as defined in the Federal Emergency Management Agency Flood Insurance Rate Map of the area. A Clean Water Act Section 404/401 permit may be required on projects which impact delineated "waters of the U.S." as defined by the US Army Corps of Engineers. • If more than 1 acre of ground is disturbed, an Arizona Pollutant Discharge Elimination System permit should be acquired from ADEQ.

4.2.4 Landscape Character Analysis

One of the overall goals of the District is to enhance the value of any flood protection facilities by preserving the Sonoran Desertscrub landscape, enhancing and protecting community character, and creating aesthetic value. The Landscape Character Analysis for the ADMP was prepared to meet this goal and the specific objectives of this study. The Landscape Character Analysis Report (refer to Part 6, Volume 1, Section 2) is organized by the geographic subareas and describes each of the 16 specific problem sites in terms of their existing visual conditions and landscape character units. The Landscape Character Analysis was used in evaluating potential flood protection alternatives and as the basis for the Landscape Character themes and aesthetic design guidelines for the Recommended Alternative.

Visual Conditions Analysis – Scenery resources of the sites were evaluated in terms of the existing visual conditions and landscape character. The existing visual conditions analysis included an identification of distinct features, notable utility and transportation corridors, areas of preservation, visually discordant features, key landmarks, and location of major viewpoints. Distinct features are those features comprising landscape elements and patterns that make a memorable visual impression. Viewpoints, as well as the other components of the existing visual conditions, are described based on publicly accessible locations. A major viewpoint is one where the distant view of distinct landforms/landmarks attracts attention away from the foreground area (area within 0.25 miles of the viewer's position).

The work product for the existing visual condition analysis is two-fold. First, a tabular description of each of the 16 problem sites and the area within the foreground distance zone is provided along with illustrative ground photographs. Second, a graphic is provided showing a spatial representation of the existing visual conditions described in the table. Examples of these work products are provided below for Site DH11 Apache Wash/24th Street in the Desert Hills area. Table 4.2 lists the key elements of the existing landscape conditions at Site DH11. Several identified features are evident in ground photographs taken during a site visit to Site DH11 (Figure 4.11). Existing visual conditions are spatially represented for Site DH11 in Figure 4.12. Similar descriptions, illustrative ground photos, and graphical representations of the existing visual condition analysis for each of the 16 structural measure sites are provided in Part 6, Volume 1, Section 2 Landscape Character Report.

Table 4.2 Existing Landscape Conditions for Site DH11

Feature Type	Description
Distinct Built Features	• Stock (water) tanks • Overhead transmission lines and towers • Carefree Highway
Distinct Natural Features	• Dense stand of paloverde trees • Apache Wash • Distant unnamed hills
Vegetation Characteristics	• Vegetation dominated by mesquite, paloverde, and acacia trees • Scattered creosotebush an bursage • No cactus species present • Vegetation cover disturbed by the cattle grazing
Terrain	• Relatively flat terrain
Notable Land Use	• Carefree Highway considered Road of Regional Significance and a designated Scenic Road • Overhead transmission lines with steel towers
Notable Viewpoints	• Carefree Highway is a major viewing platform

Figure 4.11 Existing Visual Features for Site DH11

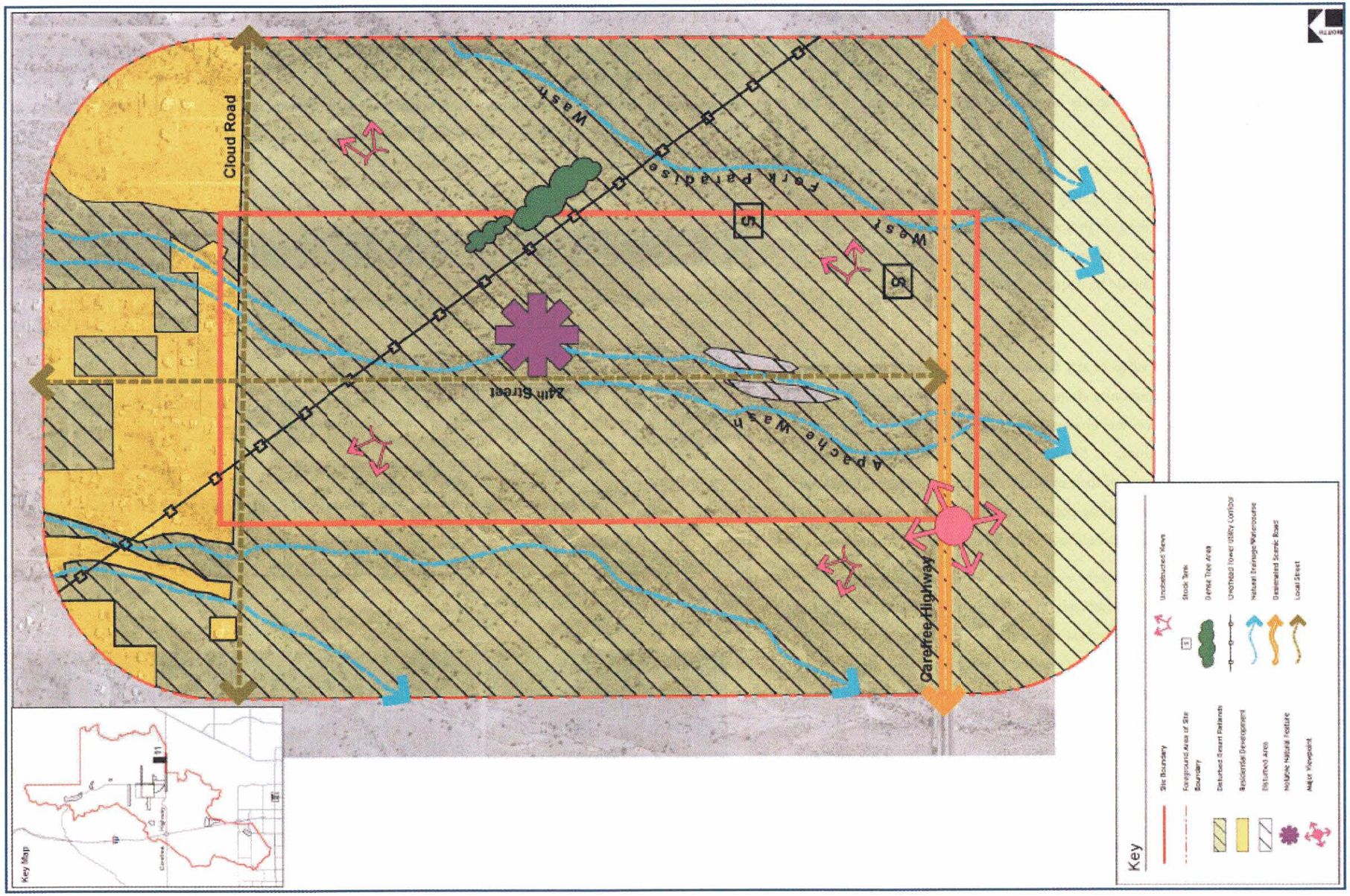


Figure 4.12 Site DH11 Existing Visual Conditions

Landscape Character Units – The second component of the scenery resources evaluation for the ADMP is the delineation of landscape character units or zones. Landscape character is the physical appearance of the landscape including the natural, physical, and architectural/cultural features that provide an identity and "sense of place." The existing landscape character is based on defining areas of similar land use, vegetation, spatial enclosure, landforms, or architectural/cultural patterns. For each landscape character unit, the relative scenic quality, level of visual intactness or scenic integrity, and visual sensitivity of the landscape were determined. Scenic quality, or attractiveness, is a combination of attributes based on landforms, water resources characteristics, vegetation patterns, and architectural/cultural elements. Scenic quality was rated as very low, low, moderately low, moderate, moderately high, high, and very high, depending on the distinctiveness, unity, and intactness of the patterns and attributes of an area. Unity is the visual coherence and harmony of the landscape when considered as a whole. Visual intactness relates to the integrity of visual order in the natural and built landscape and the extent to which the landscape elements, and patterns that they create, are cohesive. The level of visual intactness was expressed as low, moderate, or high.

The general visual sensitivity of the sites has also been determined. Visual sensitivity is the measure of people's concern for the visual environment based on the viewer's activity and awareness as well as their values, opinions, and preconceptions. The general public or jurisdictional agencies were not sent questionnaires to determine their relative sensitivity to change in the landscape. The evaluation of visual sensitivity was therefore based on viewer's potential perceptions of existing and planned land uses rather than any visual preference evaluations. Visual sensitivity was rated as high for residential and recreation uses, vacant undisturbed areas (Sonoran Desertscrub vegetation), and transportation corridors; moderate for commercial, office, retail, and light industrial uses; and low for utility corridors, existing flood control facilities, and vacant disturbed area uses.

The work products for the landscape character unit assessment include tabular summaries of the visual character, scenic quality, and visual sensitivity of identified landscape character units for each of the 16 problem sites in the ADMP study area. For example, Table 4.3 contains information for one of seven identified sample landscape character units (i.e., xeroriparian with subtle/braided channel bed) specific to Site DH11. Several identified units are evident in ground photographs taken during a site visit to Site DH11 (Figure 4.13). Landscape character units are spatially represented for Site DH11 in Figure 4.14. Refer to the Landscape Character Analysis Report (Part 6, Volume 1, Section 2) for similar information compiled for all 16 sites

Table 4.3 Landscape Character Units for Site DH11

Site DH11 Landscape Character Unit – Xeroriparian with Subtle/Braided Channel Bed	
Visual Character	**Foreground** • Braided drainage channel delineated by presence of dense xeroriparian vegetation • Grey-green, coarse-textured trees across multiple channels are dominate feature in unit • Sandy or cobbled channel bed subordinate to xeroriparian vegetation • Views beyond drainage channel partially obscured by presence of native trees along banks **Middleground** • Middleground area partially obscured from view by xeroriparian vegetation **Background** • Not visible
Scenic Quality	**Distinctiveness** • Washes within this unit are characterized by dense vegetation along channel areas • Xeroriparian vegetation creates a striking visual pattern • Drainage channel bed is notable feature providing visual interest in the landscape • Terrain is relatively flat with subtle change in grade **Level of Intactness** • Intact natural drainage • High level of intactness **Unity** • Vegetation creates a notable visual pattern in the landscape **Level of Scenic Quality** • High
Visual Sensitivity	High

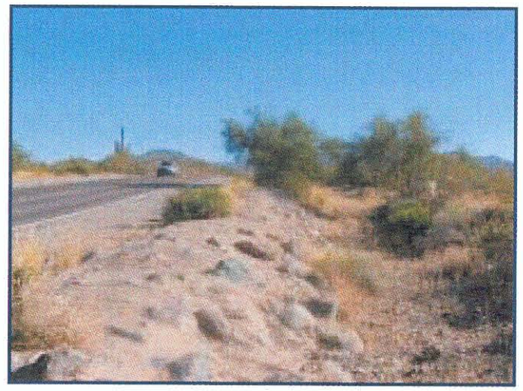


Figure 4.13 Site DH11 Xeroriparian with Subtle/Braided Channel Bed

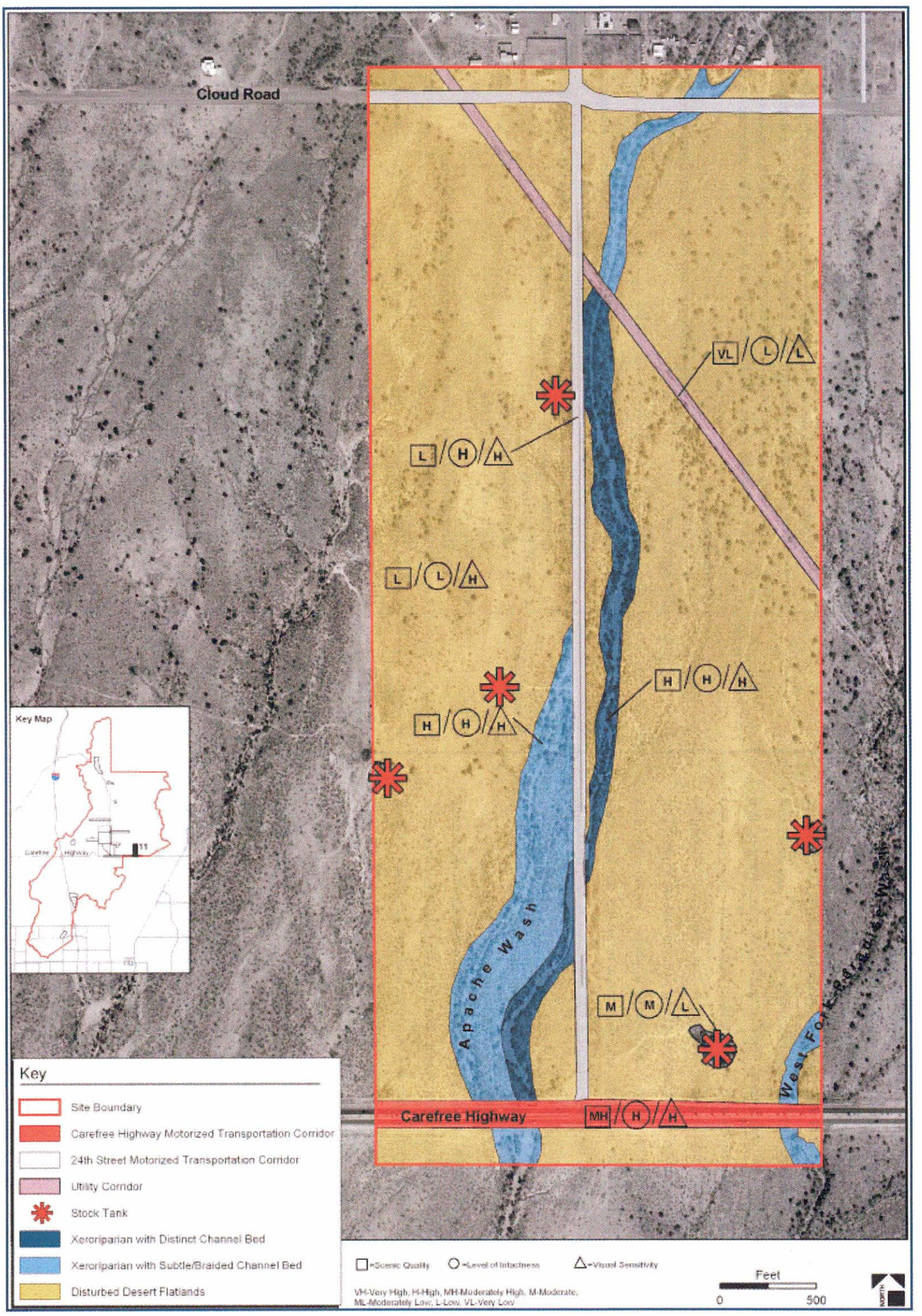


Figure 4.14 Site DH11 Landscape Character Units

4.2.5 Multiple-Use Opportunities Assessment

The District's aesthetics and open space goal is to enhance the year round value of its flood protection facilities by incorporating features that will help preserve natural Sonoran Desert landscapes, protect and enhance local community character, enhance the aesthetic value of its properties and provide public opportunities for recreation activities. The purpose of the Multiple-Use Opportunities Assessment is to identify recreation opportunities, constraints, and possible facilities within the ADMP study area. The inventory and analysis of recreation facilities and opportunities and the District's planning and design requirements were used to identify and describe the types of multiple uses that might be appropriately incorporated into the proposed alternatives (Figure 4.15). This assessment served as a basis for evaluating flood control alternatives to maximize opportunities to meet local community needs for recreation, open space, protection and enhancement of the natural landscape and local community character, and/or alternative forms of transportation. The Multiple-Use Opportunities Assessment was used to identify and describe the recreation multi-use impact potential and degree of flexibility that would exist with regard to modifying the location, type, size, depth, configuration, and other design aspects of the various components and features of the recommended flood protection alternative. In addition, conceptual level design standards for the integration of multiple-use opportunities with recommended flood control features were developed. Refer to Part 6, Volume 1, Section 3 for full documentation of the Multiple-Use Opportunities Assessment. A brief summary of results follows.

Methodology Description – To identify recreational opportunities and constraints, a regional inventory and analysis of existing and planned land uses was conducted within 1 mile of the ADMP study area. The regional study area was described according to the four geographic subareas, and local inventories and analyses were also conducted for each of the 16 site-specific problem areas. Inventory methods included a review of city and county existing land use maps and planning documents, aerial photographs, and field verification conducted in July 2003. City and county organizations were also contacted for new and updated information within the study area. Sources used to identify the existing and planned multiple-use facilities included:

- City of Phoenix General Plan (2001)
- City of Phoenix General Plan (Revised 2003)
- Sonoran Preserve Master Plan (2001)
- Maricopa County GIS Database (2002)
- Bicycle Transportation System Plan (1999)
- Maricopa County Regional Trail System Master Plan (2001)
- MAG Regional Bicycle Plan (2000)
- MAG Off-Street System Plan (2000)
- New River Area Plan (1998)
- Skunk Creek Watercourse Master Plan (2001)

Analyses were then conducted of the regional study area and of site-specific locations for opportunities to protect or restore natural and/or cultural features of the area, the types of multiple uses that might be appropriately incorporated into the project, possible partners and funding sources for implementation of multiple-use opportunities for the recommended alternative, and conceptual-level design standards for integration of multiple-use opportunities with recommended flood control facilities.

The Multiple-Use Opportunities Assessment is divided into the following five major components to document surface land uses and corresponding recreational activities within the ADMP on both a regional and local scale. A brief description of each component is provided below.

Existing Conditions and Planned Land Uses – The study area lies within the jurisdictions of the City of Phoenix, Town of Cave Creek, Maricopa County, and the Arizona State Land Department (ASLD). Lands within the study area have a combination of public and private ownership, though a substantial amount is publicly owned. Existing conditions and planned land uses were identified within the ADMP on regional and local scales, and include recreation and transportation systems.

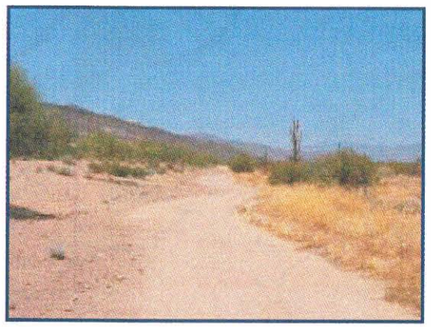


Figure 4.15 Existing Unpaved Multi-use Path in Tramonto Subdivision

As part of this study, planned and existing land uses analyzed on a regional scale are identified in the following categories: residential, commercial, public/quasi public, and industrial. Figure 4.16 shows Existing Land Use; refer to Figure 4.17 for Planned Land Use. Transportation and recreational systems were categorized and analyzed as freeways/interstates, parkways, and roads; bikeways; trails; recreation sites and parks; open space; and public transportation. Figure 4.18 presents regional Transportation and Recreation Systems in the ADMP study area. Refer to Part 6, Volume 1, Section 3 a discussion of regional land uses, transportation and recreational systems.

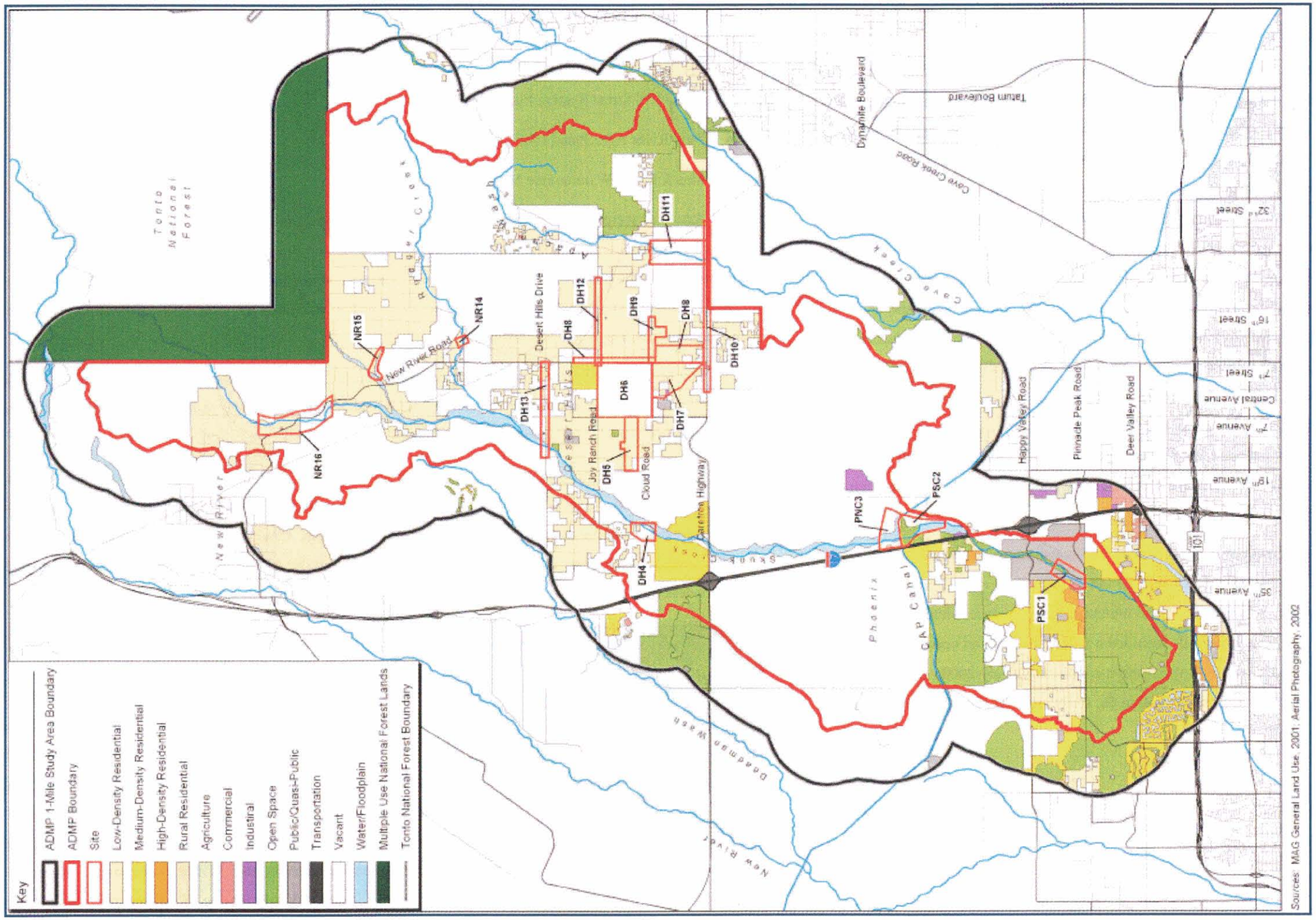


Figure 4.16 Existing Land Use

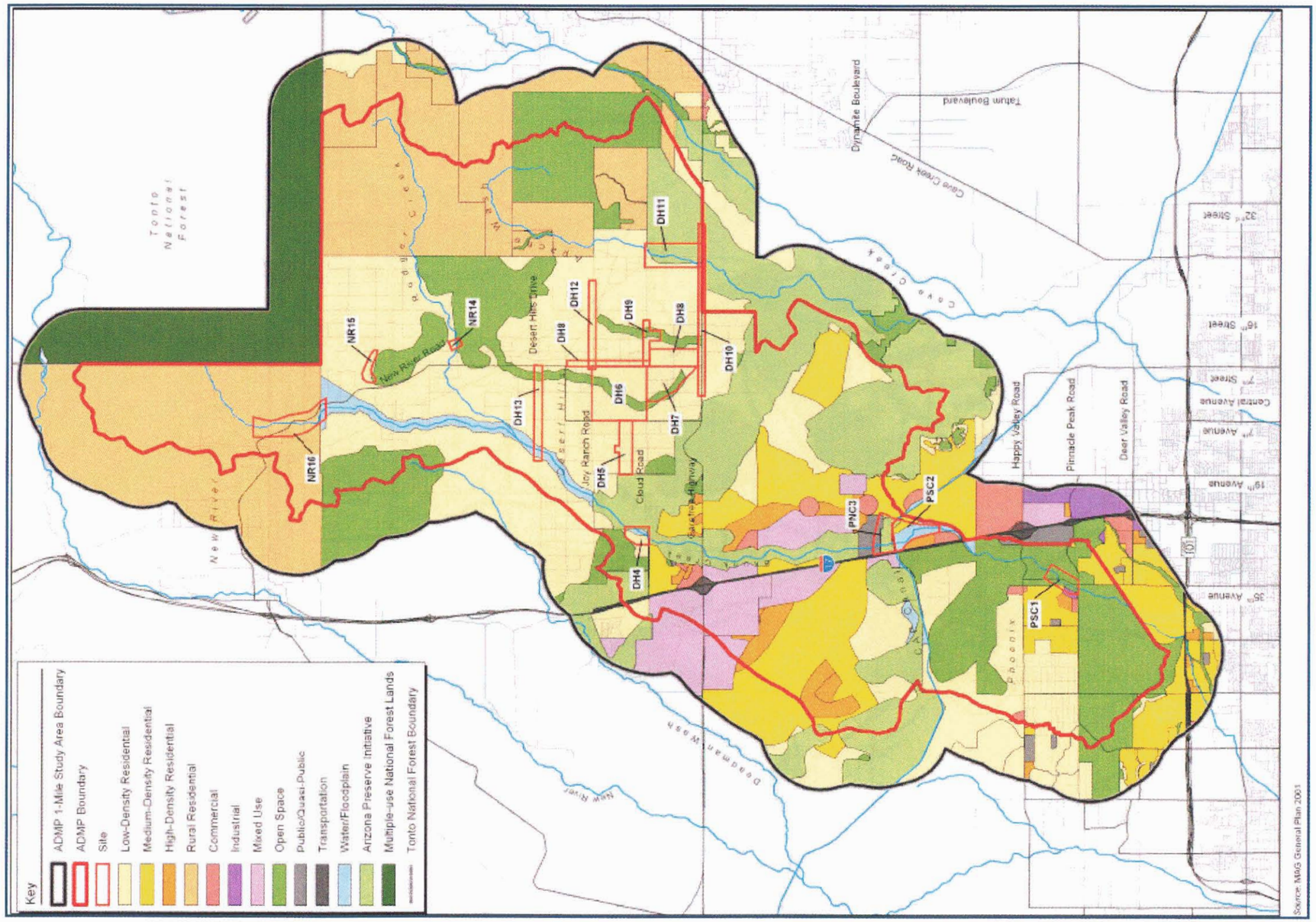


Figure 4.17 Planned Land Use

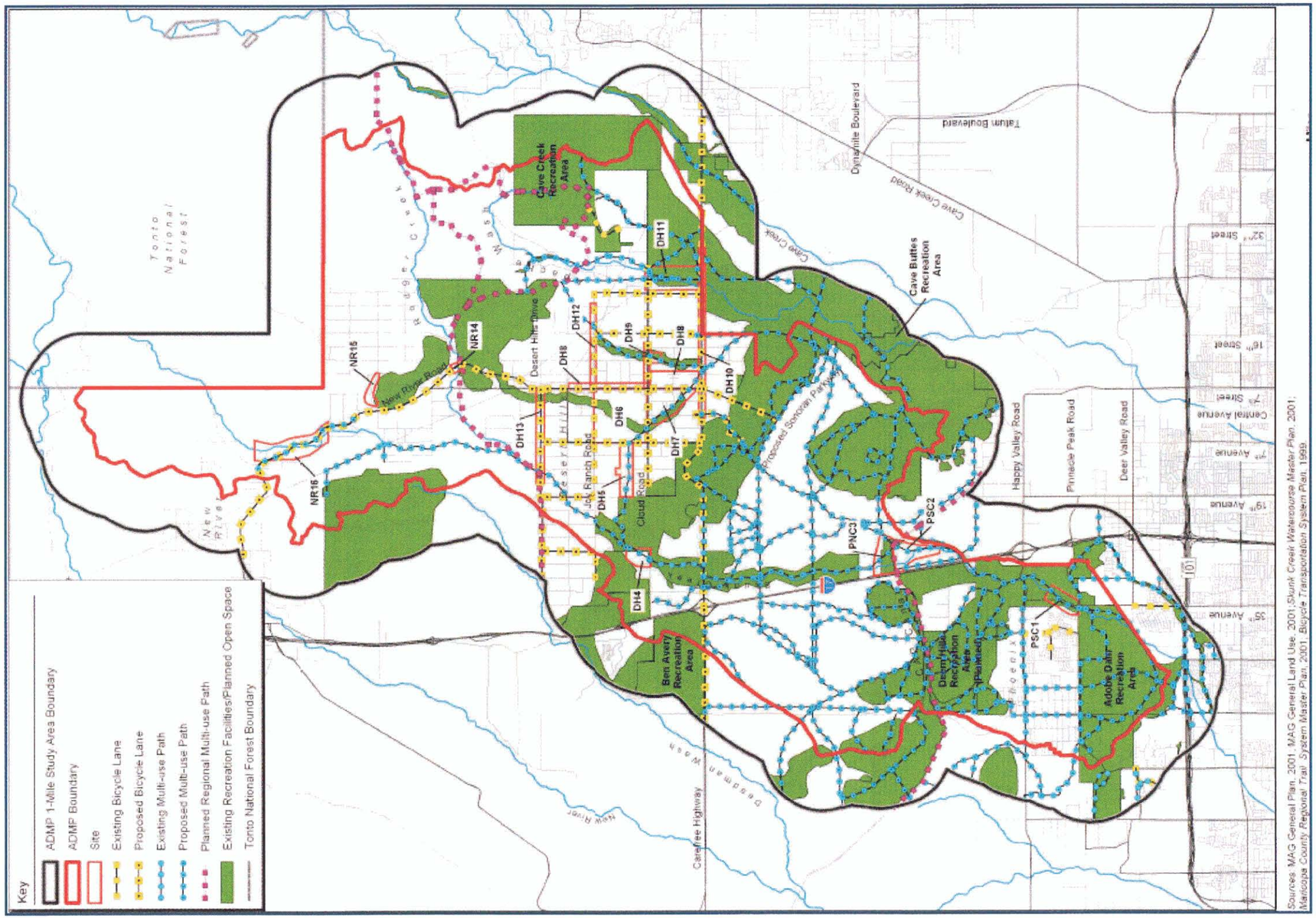


Figure 4.18 Transportation and Recreation Systems

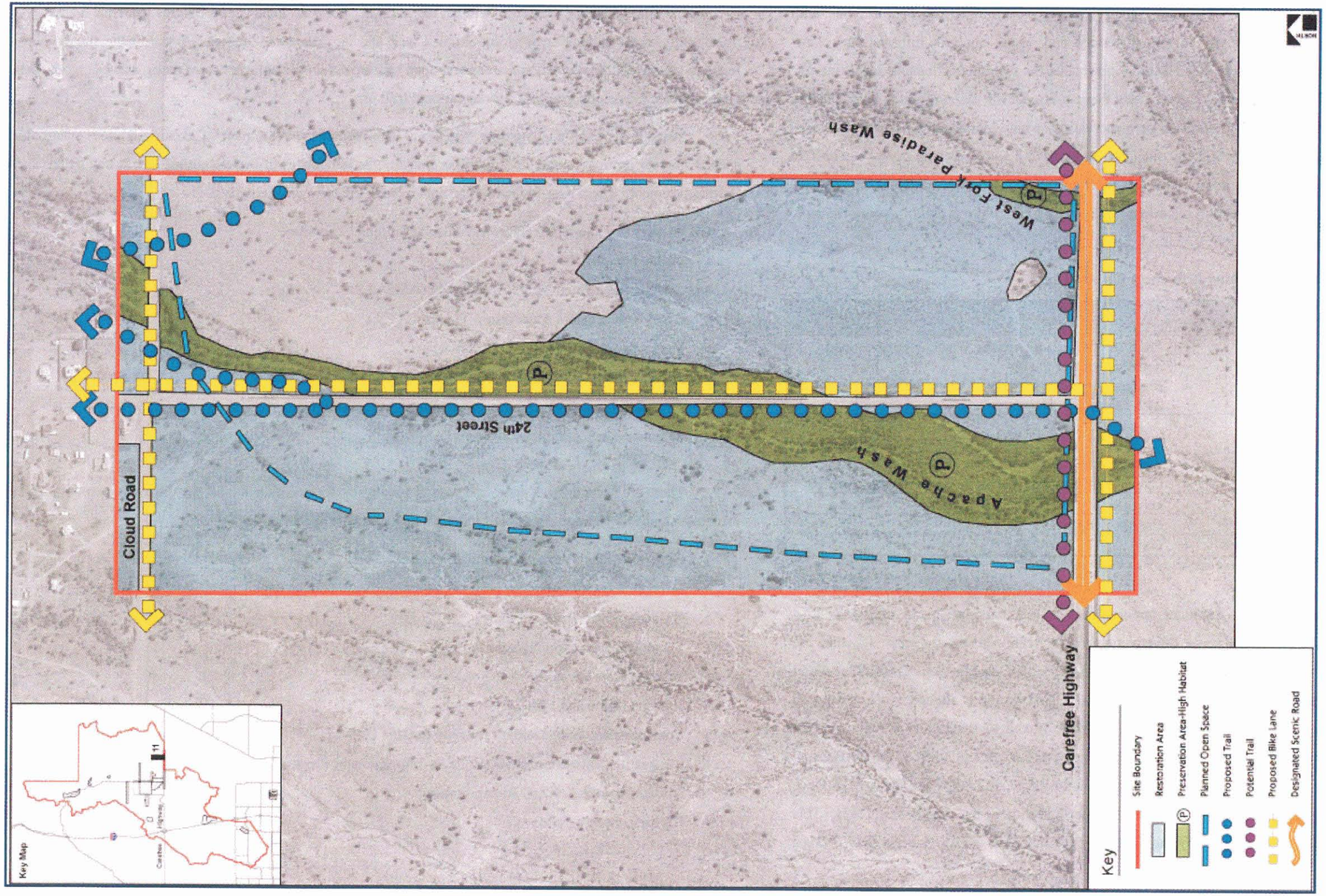


Figure 4.19 Site DH11 Planning Influences

Planning Influences and Opportunities for Protection or Restoration – Multiple-use opportunities and limitations were identified based on the analysis of the site inventory and visual analysis information. This information was compiled for each of the 16 problem sites. Table 4.4 presents the planning influences identified for Site DH11 at 24th Street and Apache Wash. Figure 4.19 graphically depicts Site DH11 planning influences. These work products also detail opportunities for habitat restoration or preservation, which identified disturbed areas and areas of habitat. They also show proposed trails identified by other master plans and potential trails that would link to both regional and proposed trails. Bikeways, neighborhood nodes, and potential passive recreation areas are also identified within the site boundaries. Similar information regarding multiple-use opportunities and limitation for each of the 16 structural measure sites are provided in Part 6, Volume 1, Section 3.

Table 4.4 Planning Influences for Site DH11

Planning Influence	Description
Planned/Proposed Multi-Use Pathways, Trails, and Bikeways	• Proposed trail along Apache Wash, 24th Street and northeast corner of site • Planned bicycle lanes along Carefree Highway and 24th Street
Potential Multi-Use Pathways, Trails, and Bikeways[1]	• n/a
Open Space/Recreation Areas	• Planned open space within the majority of the site • Cave Creek Recreational Area located to the northeast
Residential Areas	• Low-density housing located north of Cloud Road
Major Roadways	• Carefree Highway
Other Planning Influences	• n/a

[1]Potential multiple-use opportunities identified from inventory and analysis of sites within study area

Appropriate Multiple-Use Opportunities – Regional opportunities to link multi-use paths and trails to a planned regional trail system exist in several locations. Several regional recreation areas are located within the ADMP study area and link to this regional trails system. A trail corridor proposed by the Maricopa County Parks and Recreation Department (MPRD) is located along the south side of the CAP Canal, which is aligned east to west with in the ADMP study area. This Maricopa County Regional Trail could be linked to several local trails that are proposed by the City of Phoenix. A few of these local proposed trails are located south and north of the CAP Canal at the east and west end of PSC 2 and within PNC 3. The Maricopa County Regional Trail, Lake Pleasant to Cave Creek alignment, is an additional regional pathway and is located in the north section of the ADMP study area. This regional trail could link to several local trails identified by the *Sonoran Preserve Master Plan* and the *Skunk Creek Watercourse Mater Plan*.

Existing drainage features within the ADMP provide local opportunities to link many local trails. Specifically, these include areas along Skunk Creek and its primary tributaries. Additionally, the existing drainage features located within recreational areas and open spaces and within adjacent areas along existing roads, schools, and parks provide prime opportunities for recreational trail use.

Possible Partners and Funding Sources – The use and development of existing or new stakeholder group, special interest groups, private and public organizations, not-for-profit organizations, etc. is key to the success of a proposed project. These possible partner groups include the following:

- Deer Valley and North Gateway Village Planning Committee
- Valley Forward
- Arizona State Horseman's Association (ASHA)
- Local Homeowners Association/ Groups
- Maricopa County Trails Commission
- Phoenix Mountain Preservation Council
- Central Arizona Water Conservation District (CAWCD) Board of Directors
- Arizona State Committee on Trails (ASCOT)

There are several local, state, and federal funding opportunities available for the implementation of trails, trail crossings, and trail signage. Possible funding sources include the following:

- General funds of the affected municipalities
- General obligations bonds
- Highway User Revenue Fund
- Local Transportation Assistance Fund
- Arizona State Parks Heritage Funds
- Arizona Game and Fish Department
- Transportation Enhancement Activity Funds (TEA-21)
- Congestion Mitigation and Air Quality Improvement Program (CAMQ)
- Bridge Replacement and Rehabilitation
- Highway Safety Funds

Conceptual-Level Design Standards – Conceptual design standards for non-motorized trails, trail roadway crossings, and trail signage are described in the Multiple-Use Opportunities Assessment Report (Part 6, Volume 1, Section 3). These standards address the following features:

- Surface
- Grade
- Resting Intervals
- Width
- Cross Slope
- Vertical Clearance
- Horizontal Clearance
- Surface Openings
- Safety Railing
- Design Speed
- Sight Distance
- Horizontal Curvature
- Vegetation
- Signage

4.2.6 Flood Response Plan

The purpose of the Flood Response Plan (FRP) is to reduce the potential for property damage and loss of life resulting from floods on identified hazardous watercourses. In addition, the FRP is one of the nonstructural elements of the Recommended Alternative in the ADMP. The FRP comprises Part 7, Volume 1 of the ADMP deliverables.

The FRP was developed under the guidance of the District. In addition, the Maricopa County Department of Transportation (MCDOT), Maricopa County Department of Emergency Management (MCDEM), Maricopa County Sheriff's Office (MCSO), Phoenix Central Alarm, and Daisy Mountain Fire Department (DMFD) provided input about local emergency response resources. The FRP is intended to function independently as a stand-alone document, and to be added as an Appendix to the FCDMC Flood Emergency Response Manual and MCDEM Maricopa County Emergency Operations Plan (2002).

Flood Vulnerability – The categories of flood vulnerabilities addressed in the FRP include the following:

Roadway Crossings – Roadway drainage crossings in the area were evaluated for the purpose of quantifying the frequency of the threshold discharge associated with six inches of flow depth over the roadway. Only primary arterial roadways and "gateway" roadway locations were evaluated directly. Results of the roadway crossing evaluations are illustrated in Figure 4.20. Numerous roadways are closed by less than the 2-year event. Many of those roads are smaller local streets. However, even along the major arterial streets some crossings become impassable for events less than the 10-year event.

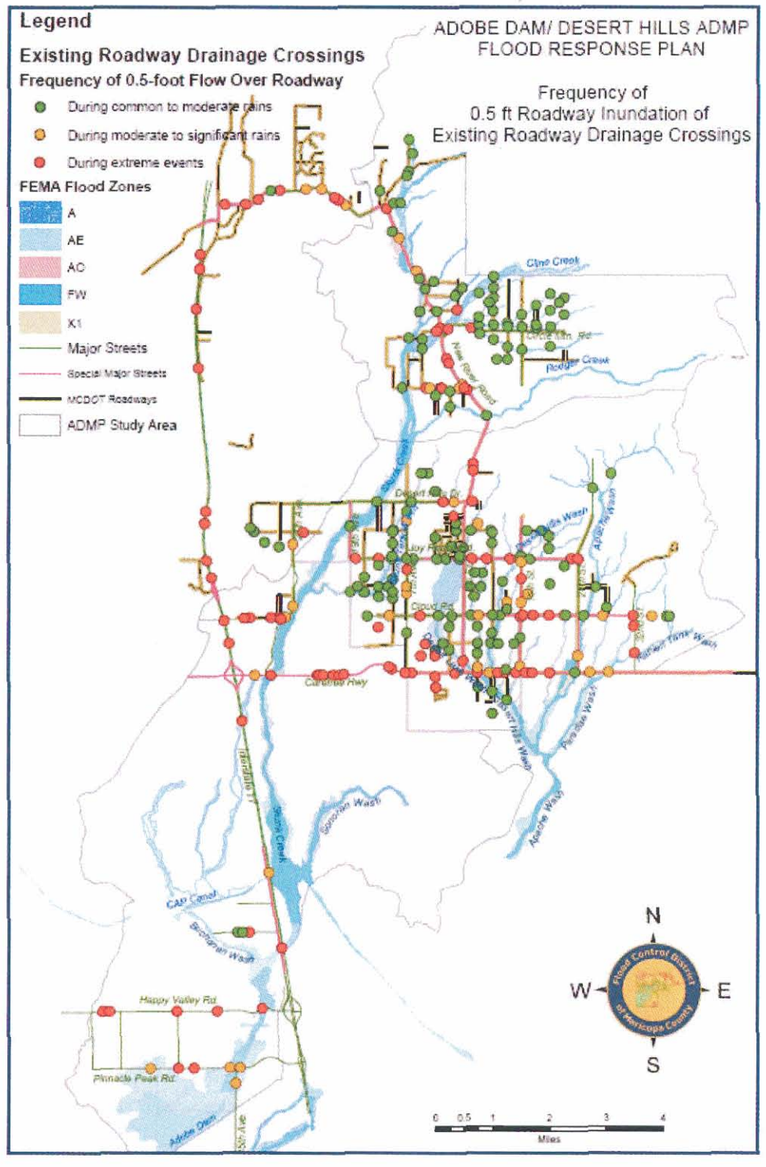


Figure 4.20 Recurrence Interval of Roadway Drainage Crossing Impassability

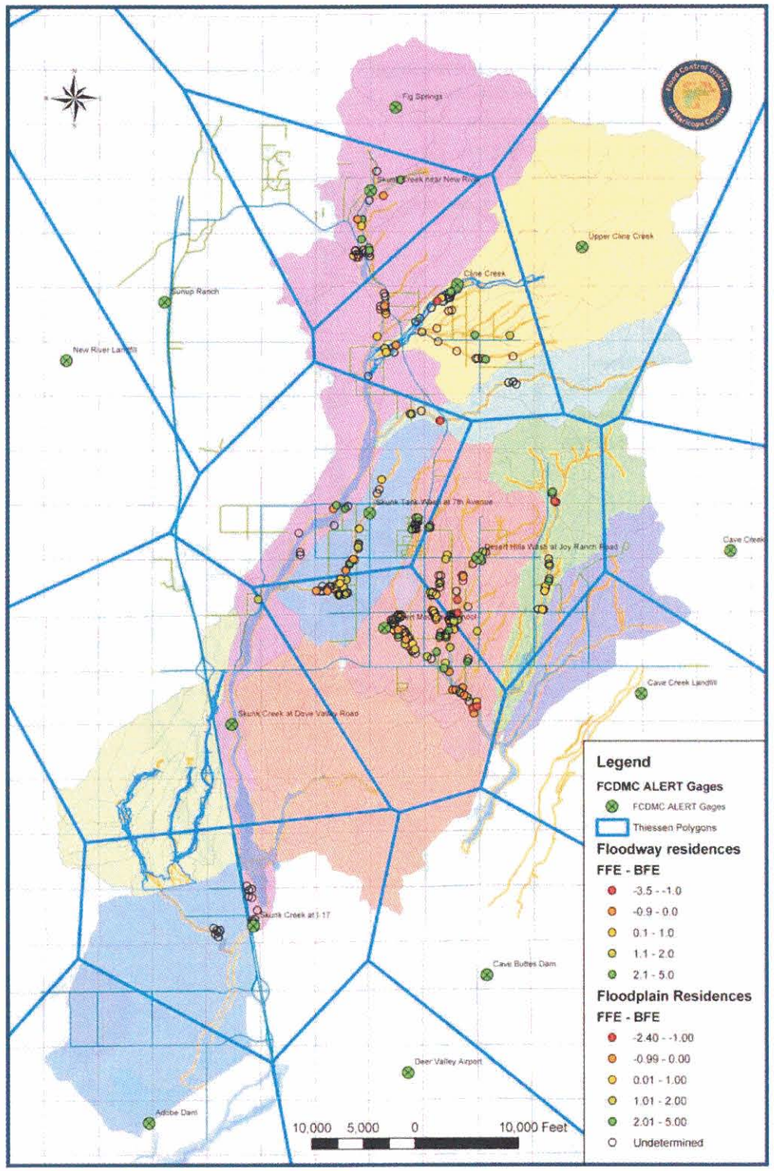


Figure 4.21 Flood Vulnerable Residences

Floodway/Floodway Fringe Residents – In addition to overtopping of roadway crossings, inundation of occupied residential structures during flood events creates potentially life-threatening hazards. The FRP addresses both identification and notification procedures for flood vulnerable structures. Residents from flood impacted structures will be notified by the Community Emergency Notification System (CENS) as described below. Figure 4.21 shows a spatial summary of the location of flood vulnerable residences and their spatial distribution relative to their depth of flooding in the 100-year flood.

Leadtime Estimation – The amount of the effective lead time for a particular watershed depends on the relative balance of the rate of response to flood-generating rainfall– or "flashiness" – of the physical system to the time required for emergency responders to implement flood response activities. Based on an assessment of hydrologic lead time (the time between the flood producing rainfall and the arrival of the flood wave at the point of interest) and response time (the decision time needed to assess the flood event and issue warnings and the action time required by the local emergency response agencies to implement the appropriate action protocols), the effective lead time for the Adobe FRP area is less than zero for most of the flood vulnerabilities. This fact and the results of the effective lead time analysis from previous flood response plans lead to the following conclusions about flood detection criteria and emergency preparedness in the development of the Adobe FRP:

1. A prediction-based FRP is not recommended due to the likelihood for false positive flood warnings. However, existing predictive tools such as the National Weather Service (NWS) and Meteorological Services Program (MSP) forecast products should be utilized to raise agency awareness that the issuance of flood alerts and the implementation of emergency action plans may become necessary.
2. A detection-based FRP is recommended. Reports of heavy rainfall or critical water levels in watercourses from observers in the field should take precedence over measured data. Given the rapid response times for the watersheds affecting the area, rainfall detection thresholds need to be set so as to trigger flood alerts before the end of the total storm rainfall. Similarly, flood alerts based upon water levels at stream gages need to be triggered before critical thresholds are reached in order to provide emergency response time.
3. Emergency response times must be minimized by:
    1. an efficient and reliable means of dissemination of flood warnings and updates to response agencies and the public;
    2. emergency action plans that are streamlined with responsibilities that are clearly understood; and
    3. proper training for key personnel for all FRP agencies and regular flood exercises.

4. Recommended improvements and updates to the FRP can serve to optimize effective lead times to the extent possible given the constraints of the physical hydrologic system.

Flood Detection – Flood detection in the Adobe FRP area will be based on the existing and proposed flood detection network. Detection is focused on providing information regarding the flood vulnerability groups discussed above. Flood detection is a balance between time and accuracy. While the prediction of a flood provides residents and emergency responders more time to prepare and react, prediction also contains a high level of uncertainty or potential for false alarms. On the other extreme, direct observation of flooding provides a high level of certainty regarding the occurrence of flooding, but leaves much less time to respond. The flood detection criteria selected for the Adobe FRP attempt to balance these extremes.

Flood Detection Network - Figure 4.22 shows the existing and proposed flood detection network for the ADMP study area. Land ownership is also shown for reference. The existing flood detection network consists of six rain gages located within the watershed and an additional six in the surrounding area. Four water level sensors are co-located with rain gages in the watershed – two on Skunk Creek, one on Cline Creek, and the fourth on Adobe Dam itself.

The proposed Automated Local Evaluation in Real Time (ALERT) gage stations fill a previously ungaged area between Adobe Dam and upper Skunk Creek. Four new locations are proposed including three rain/stream sites, and one weather station at Desert Mountain School (DMS). Of the three proposed water level sensors, one is proposed for Skunk Tank Wash at 7th Avenue, one on Desert Hills Wash at Joy Ranch Road, and the third, on Skunk Creek at the Dove Valley Road alignment (future bridge site). The new stations' purpose is to provide detection and verification of flood producing rainfall and consequent runoff for areas with extensive or special flood vulnerable structures and/or residences. In particular, the new gages will provide detection of potential closure for Interstate 17 and warning of flood vulnerable residences on Skunk Tank, Desert Lake, and Desert Hills Washes.

Flood Detection Criteria - Based on the proposed completed flood detection network described in the preceding section, a series of flood detection criteria were established. These criteria vary for the two primary flood vulnerability groups: roadway drainage crossings and floodplain residences. Five color-coded flood alert levels were defined based on frequency of flood threat. The names and nature of the flood alerts for the Adobe FRP generally correlate to the color-coded alert levels in other District FRPs. The five color-coded zones and their meanings for the Adobe FRP are briefly described below.

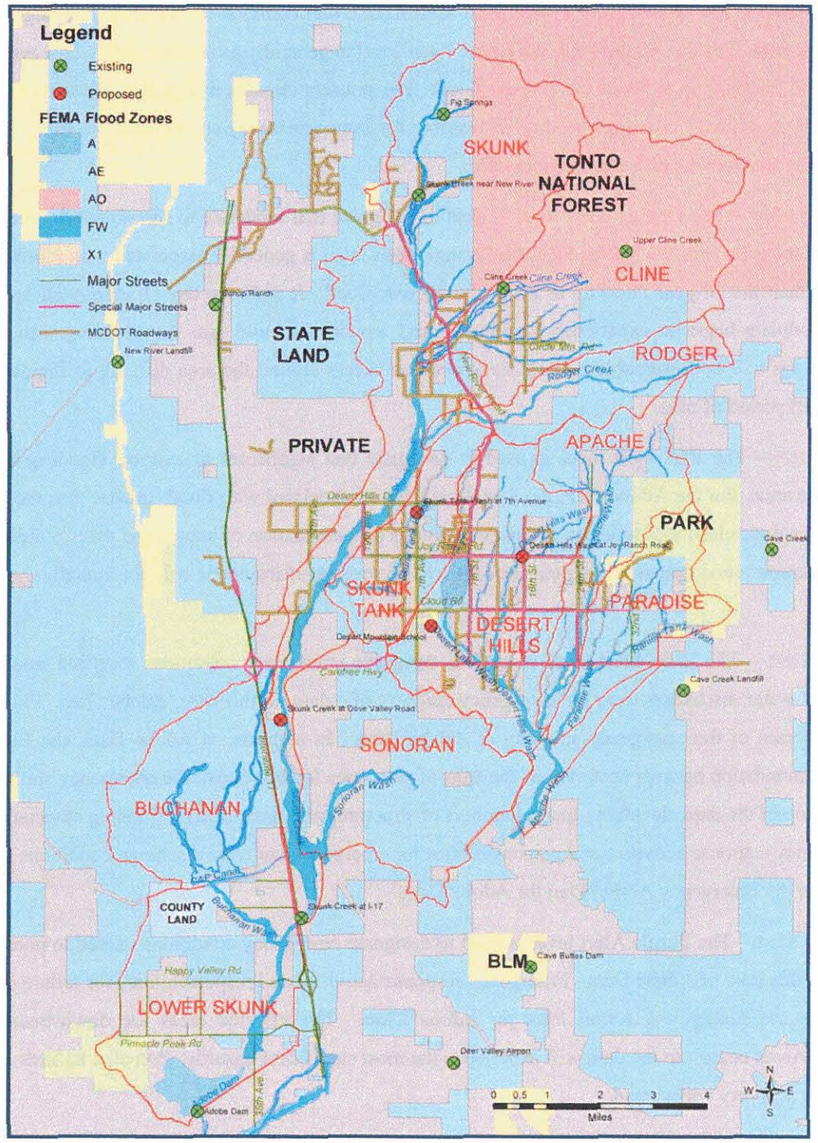


Figure 4.22 Flood Detection Network

Green Alert – The Green Alert level is used to designate that common-to-moderate flooding is imminent or occurring in the area. For the Adobe FRP, the Green Alert level is generally associated with storm events capable of generating some flooding up to about the 10-year flood. The primary impacts of flooding for a Green Alert are that numerous roadway drainage crossings become impassable for some (relatively short) period of time. Transportation to portions of the area may be difficult or impossible.

Orange Alert – The Orange Alert level is used to designate that moderate to significant flooding is imminent or occurring in the area. For the Adobe FRP, the Orange Alert level is generally associated with rainfall and/or flood events greater than the 10-year flood up to about the 50-year flood. It is above this Orange Alert level that homes within the floodplain begin to experience flooding in and around the buildings. In addition, numerous roadway drainage crossings will be impassable making transportation access around the area difficult to impossible for some (relatively short) period of time.

Red Alert – The Red Alert level is used to designate that significant to extreme flooding is imminent or occurring in the area. For the Adobe FRP, the Red Alert level is associated with floods greater than the 50-year flood. Flood hazards include closure of roadway drainage crossings and inundation of homes and other buildings within the floodplain. Transportation access throughout the area will be severely disrupted if only for a relatively short duration of time.

Blue Alert – The Blue Alert level is used to designate emergency conditions resulting from imminent or occurring flood water discharges from the emergency spillway of a dam, in this case, Adobe Dam. Flood hazards are located downstream of the emergency spillway of Adobe Dam. In addition, at Adobe Dam, the Blue Alert level would include inundation hazards upstream of the dam of structures located above the emergency spillway elevation, but below the top of the dam elevation. Large numbers of structures are threatened by flooding associated with a Blue Alert. Emergency response activities and responsibilities for emergency spillway discharge conditions at Adobe Dam are described in the Emergency Action Plan for Adobe Dam.

Purple Alert – The Purple Alert level is used to designate emergency conditions related to potential or actual dam failure, in this case of Adobe Dam. Emergency response activities and responsibilities for failure of Adobe Dam are outlined in the *Emergency Action Plan for Adobe Dam*. The affected areas are downstream of the dam embankment. Areas nearest to the dam will experience the most significant hazards. Potential hazards are considered life-threatening and very widespread.

Specific quantitative detection criteria were selected to trigger each alert level for roadway drainage crossings and floodplain residences. Table 4.5 summarizes the flood detection criteria recommended for implementation for the FRP. Refer to Part 7, Volume 1 FRP Technical Memorandum (TM) for further detail.

Table 4.5 Summary of Flood Detection Criteria

Flood Alert	Description of Flood Vulnerable Areas	Rainfall Detection Criteria	Water Level Detection Criteria
Green	At-grade and small culvert roadway drainage crossings	0.5" / 30 min.	
Green		1.0" / 30 min.	2-year flow
Orange	Additional roadway drainage crossings and floodplain residences	1.4" / 30 min	10-year flow
Red	Additional roadway drainage crossings and floodplain residences	1.8" / 30 min.	50-year flow
Blue	Areas downstream of emergency spillway and above emergency spillway crest elevation within the flood pool area of Adobe Dam	2.8" / 60 min.	1) Observer 2) 38.5 ft gage height
Purple	Areas downstream of Adobe Dam embankment	N/A	1) Observer 2) Rate of Fall
Special Skunk Creek Roadways	Roadway drainage crossings of Skunk Creek	N/A	Various See FRP TM

Note: Flood vulnerable roadway drainage crossings shown on Figure 4.20.
Flood vulnerable residences shown on Figure 4.21.

Information Dissemination - There are two primary groups who will require dissemination of information amongst themselves. The first group is the agencies. This group includes the District, NWS, MCDOT, MCDEM, MCSO, MC Parks, DMFD, COP, DPS, ADOT, CAP, and the Town of Cave Creek. The second group is the public. The general public will be especially subject to hazards at roadway drainage crossings. Residents in the floodplain represent a special portion of the public to whom communication of impending flooding will be especially important. Finally, visitors to the Cave Creek Regional Park may require some contact regarding impending or occurring flooding.

In the first group (agencies), remotely sensed data (radar or ALERT) comes into the District and the NWS. They utilize/interpret these data based, in part, on the flood detection criteria described above. If threatening conditions are expected or detected, they notify the other agencies and/or the public. NWS can alert the general public via NOAA Weather Radio and the Emergency Alert System (EAS). The District alerts sister County agencies

who either respond directly or use their own internal mechanisms to contact additional effected parties. MCDEM serves as the primary disseminator of emergency information for the County. Park visitors will be alerted by Maricopa County Parks personnel.

The Community Emergency Notification System (CENS) will be used to contact floodplain residences. CENS is a telephone-based emergency notification system that utilizes reverse 911 capabilities to quickly disseminate recorded voice messages advising call groups of emergency conditions and recommended emergency response actions. The District's Flood Warning Branch will initiate the CENS message calls for the affected CENS group(s). Given the clustered nature of the residences in the floodplain (see Figure 4.22), a number of warning areas were identified for flood warning notification. Warning will be given to floodplain residents via telephone using CENS. Predefined polygons can be used to select the most current phone numbers and make a phone call to the flood vulnerable residents at their home. Figure 4.23 shows the CENS areas. Flood warning messages can be targeted to specific resident groups depending on which watercourses are in flood stage. Not all groups need to be notified if flooding is isolated to one or a few watercourses.

The message suite for the Adobe FRP is comprised of flood warning messages issued by the NWS, District MSP, and CENS. Each of these three groups of messages will be disseminated to emergency response agencies using multiple means of communication, including telephone, radio, and fax. Notification via multiple paths is provided for redundancy and robustness of the flood warning system. See the FRP TM (Part 7, Volume 1) for a discussion of the message suite, communication means, and flowchart of communication paths. The issuance of any of the warning messages will trigger emergency response per the action plans as described in the FRP. Implementation of the FRP will require training and planned flood exercises. The FRP will require periodic updates and various follow-up activities, such as a public education program to ensure area residents are aware of flooding hazards and the potential for flood warning notification via CENS.

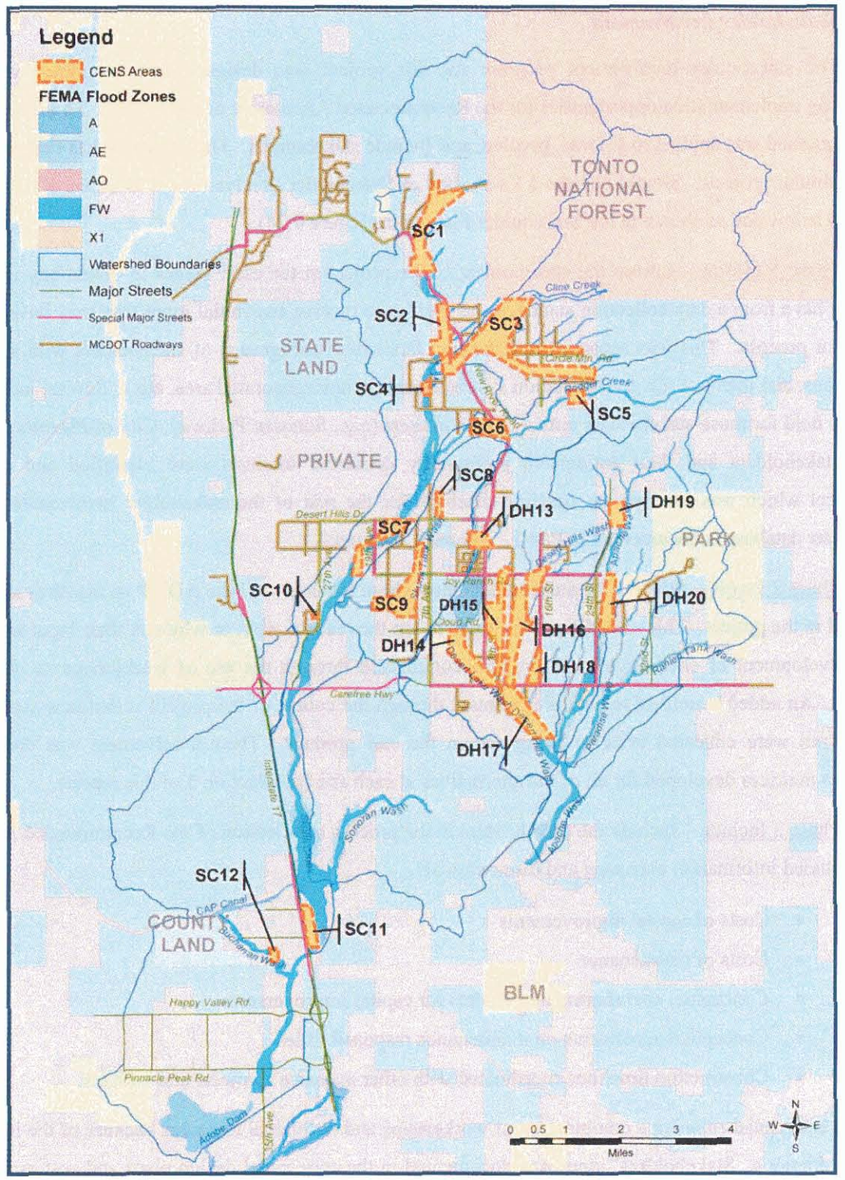


Figure 4.23 Location of CENS Warning Areas

4.2.7 Stakeholder Involvement

The stakeholder involvement program for this project was designed and completed with the goal of maximizing implementation opportunities for the Recommended Alternative of the ADMP. To achieve this objective, the 3 **I**'s method was applied to **I**nform, **I**nvolve, and **I**nclude stakeholders. This approach has been used successfully in other similar projects. Simply put, the 3 I's method of Stakeholder Involvement is to utilize a 3-Phase approach as described below and as shown in the Stakeholder Flowchart (Figure 4.24).

Phase 1 Inform – Inform the stakeholders of the project at the early stages to obtain any useful knowledge they may have from a data collection standpoint as well as to receive any initial input they may have regarding scope of work or process. This was accomplished through facilitated workgroups of stakeholders with similar mandates, jurisdictions, and interests (i.e. transportation system agencies, unincorporated area, etc.). Several individual meetings were also held for those stakeholders with a unique interest (e.g., Sonoran Parkway, City of Phoenix Transfer Station, etc.). Stakeholders and their anticipated preliminary concerns/ interests were identified and compiled into a spreadsheet which was used as the baseline database for the rest of the stakeholder involvement program. The Stakeholder database is documented in Part 1, Volume 1, Section 2.

Phase 2 Involve –Involve the stakeholders throughout the course of the ADMP so that they stay informed and interested in the project. This also allowed for them to see the reasons why, or why not, their input would be included in the development of alternatives. This was accomplished through the use of workgroups as well as individual meetings. An added benefit of maintaining contact through the course of the project is that new staff members from the agencies were educated prior to being shown the end product. Their involvement was documented in the evaluation matrices developed for all of the alternatives at each site (see Section 5 of this report).

Phase 3 Include – Include the stakeholders in the process of selection of the Recommended Alternative. This effort included information exchange and discussion of:

- Costs of capital improvements
- Costs of maintenance
- Conceptual cost sharing agreements for capital improvements
- Conceptual agreements on maintenance responsibilities
- Construction timelines coordinated with other agencies' projects and budgets.

This was accomplished using a combination of workgroups and individual meetings because of the iterative nature of these negotiations. Stakeholders' input was documented in the conceptual design plans and cost estimates contained in Part 9, Volume 1 of the ADMP Recommended Alternative Report.

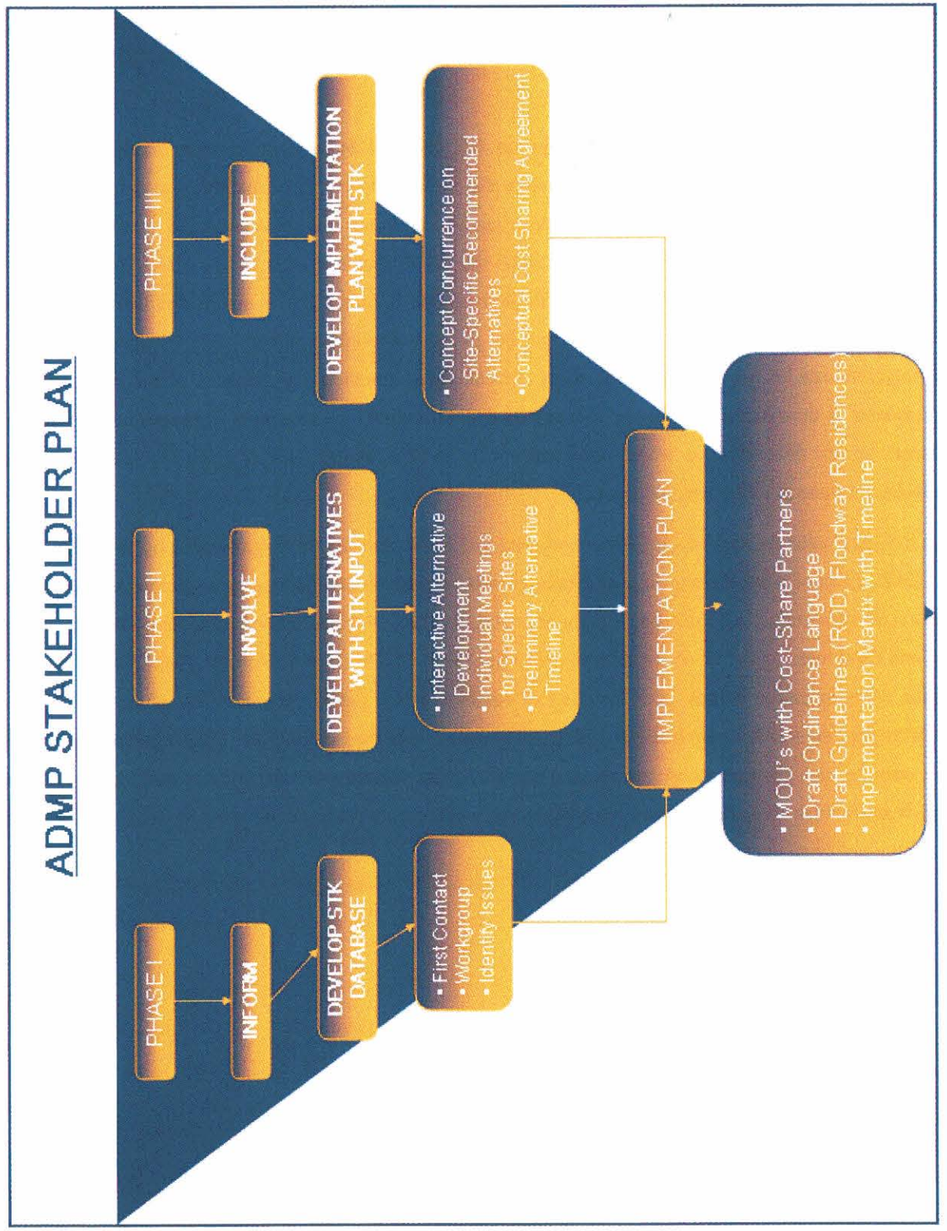


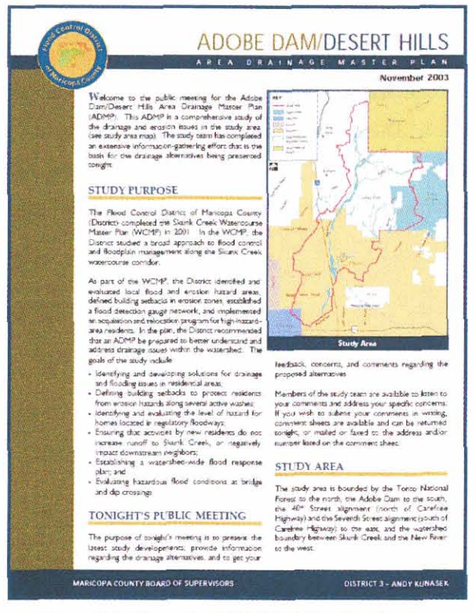
Figure 4.24 ADMP Stakeholder Plan

4.2.8 *Public Involvement*

The District began a public involvement process for the ADMP in September 2002. The Public Involvement Plan created a blueprint for the public involvement process that would give the public multiple opportunities to ask questions and provide feedback to the District. The public involvement efforts centered on three sets of public meetings, with each set comprising three separate meetings. The three sets of meetings were scheduled in relation to project development stages: one set in the Phase I information gathering stage in November 2002, one set during the Phase II alternatives development in November 2003, and the last set to present the Recommended Alternative in September 2004. In each set, the public meetings occurred within a two-week timeframe. Because the project area is so large and to reduce the travel burden on potential attendees, each of the three meetings was held in a different location – one in the southern portion of the project area, one centrally located, and one in the north. During the public involvement process, the District decided it would be best to have two separate meetings designed specifically for residents who owned property in the floodway. These meetings were each scheduled in November 2003 and September 2004 prior to the final two sets of public meetings.

The public involvement program for the ADMP is documented in Part 1, Volume 1, Section 3. The work products presented therein are listed below:

- Public Involvement Summary Report
- Public Involvement Plan
- Postcards
- Fliers/ Doorhangers
- Newspaper Notices
- Notification Letters
- Handouts
- Sign-in Sheets
- Meeting Summaries
- Public Meeting Presentations
- Exhibit Boards


ADOBE DAM/DESERT HILLS

AREA DRAINAGE MASTER PLAN

November 2003

Welcome to the public meeting for the Adobe Dam/Desert Hills Area Drainage Master Plan (ADMP). This ADMP is a comprehensive study of the drainage and erosion issues in the study area (see study area map). The study team has completed an extensive information-gathering effort that is the basis for the drainage alternatives being presented tonight.

STUDY PURPOSE

The Flood Control District of Maricopa County (District) completed the Skunk Creek Watercourse Master Plan (WCMP) in 2001. In the WCMP, the District studied a broad approach to flood control and floodplain management along the Skunk Creek watercourse corridor.

As part of the WCMP, the District identified and evaluated local flood and erosion hazard areas, defined building setbacks in erosion zones, established a flood detection gauge network, and implemented an acquisition and relocation program for high-hazard-area residents. In the plan, the District recommended that an ADMP be prepared to better understand and address drainage issues within the watershed. The goals of the study include:

- Identifying and developing solutions for drainage and flooding issues in residential areas;
- Defining building setbacks to protect residents from erosion hazards along several active washes;
- Identifying and evaluating the level of hazard for homes located in regulatory floodways;
- Ensuring that activities by new residents do not increase runoff to Skunk Creek, or negatively impact downstream neighbors;
- Establishing a watershed-wide flood response plan; and
- Evaluating hazardous flood conditions at bridge and dip crossings.

TONIGHT'S PUBLIC MEETING

The purpose of tonight's meeting is to present the latest study developments, provide information regarding the drainage alternatives, and to get your feedback, concerns, and comments regarding the proposed alternatives.

Members of the study team are available to listen to your comments and address your specific concerns. If you wish to submit your comments in writing, comment sheets are available and can be returned tonight, or mailed or faxed to the address and/or number listed on the comment sheet.

Study Area

STUDY AREA

The study area is bounded by the Tonto National Forest to the north, the Adobe Dam to the south, the 40th Street alignment (north of Carefree Highway) and the Seventh Street alignment (south of Carefree Highway) to the east, and the watershed boundary between Skunk Creek and the New River to the west.

MARICOPA COUNTY BOARD OF SUPERVISORS

DISTRICT 3 - ANDY KUNASEK

Figure 4.25 November 2003 Public Meeting Handout

The District maintained a project web site for the ADMP to provide residents the opportunity to access project-specific public information materials digitally and to provide a means for residents to submit inquires or requests for information directly to the District's Project Manager. The web site URL is as follows:

http://www.fcd.maricopa.gov/Neighborhood/ProjectDetails.asp?wPROJECT=42

The District also met with the staff of the local newspaper in the project area in conjunction with the public meetings. A project fact sheet was prepared to provide concise information about the project to members in the community, press, and the public.

4.2.9 *Planning/ Regulatory Coordination*

Nonstructural measures were evaluated as part of the Phase I alternatives development process. The nonstructural measures considered planning issues resulting from policies and/or regulations pertinent to the ADMP project and assessed opportunities and obstacles created by adopted codes, ordinances, and development conditions. As a result, the nonstructural measures included the preparation of development guidelines for structures and roads in the study area and an evaluation of floodproofing options for floodway residents. These two nonstructural components are briefly discussed below.

Phase I Interim Development Guidelines –The general objectives of the Interim Development Guidelines include the following:

- Enhance public safety by guiding development in the watershed to protect current and future residents from the effects of flooding.
- Reduce adverse drainage impacts due to development in the watershed by guiding activities of new residents so that current runoff to Skunk Creek is maintained at current conditions and downstream neighbors are not negatively impacted.
- Guide future development in a manner consistent with the Recommended Alternative plan of the Adobe ADMP.

The intended purpose of the interim development guidelines is to provide guidance to residents and regulators alike regarding what can and cannot be constructed, ways to alleviate the impacts of construction on the watershed, and how to protect structures and adjacent properties from flooding and erosion. Meetings were held with several groups to better understand the issues prior to and during the process of formulating the Interim Development Guidelines. Input was solicited from the following county, municipal, and private participants during group and/or individual meetings: Maricopa County Supervisor Andy Kunasek; District floodplain managers, planners, and

inspectors; City of Phoenix Councilwomen Peggy Neely; North Gateway and Desert View village planning committees. In addition, an informational meeting was held with the Development Guidelines Work Group comprising of regulators, planners, hydrologists, land development engineers, and project area residents representing the New River/Desert Hills Community Association. The group was convened to discuss flooding and drainage issues and regulation as input to the interim development guidelines formulation. Refer to Part 8, Volume 2, Section 3 for further information regarding the Phase I development guidelines.

A careful analysis of area development trends and regulatory options was conducted to identify specific issues that were not addressed by the existing Arizona Revised Statutes (ARS) Title 11 Drainage Ordinances and ARS Title 48 Floodplain Regulations (see Figure 4.26). Title 48 authorities apply to the 100-year flood areas regulated by the National Flood Insurance Program (NFIP) and Arizona Department of Water Resources. Title 11 authorities regulate drainage concerns in areas outside the regulatory 100-year floodplain. In practice, Title 11 authorities sometimes overlap into the Title 48 area. It became apparent that single-family development on individual lots within unincorporated areas was the one category with insufficient standards to address the cumulative impacts of this type of development.

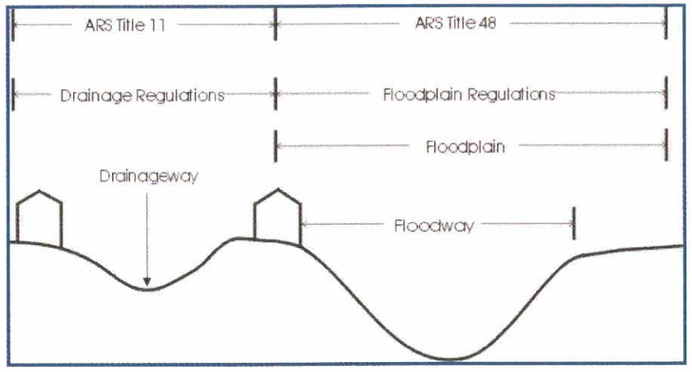


Figure 4.26 Statute Applicability

This analysis documented the existing practices and procedures and carefully integrated a unique toolkit and implementation strategy to address individual single-family lot development. By maximizing resources, both technical and personnel, a significant percentage of reviews may be simplified. An option is also available for individuals to obtain approval for variations to the regulations if a higher degree of drainage analysis is provided in order to justify the proposed change(s). By providing this degree of flexibility within clearly documented and easily applied Development Guidelines, both the public and regulatory staff will benefit.

A number of tools or criteria were evaluated for application to single-lot development in the ADMP study area. The tools were evaluated based on their hydrologic efficacy, long-term viability, and their potential for implementation. Seven types of tools or criteria relating to single-family, individual lot development were examined:

- Drainageways
- (Erosion Hazard) Setbacks
- Finished Floor Elevations
- Disturbance Envelopes
- Culverts, Driveways, & Roads
- Walls, Fences, & Berms
- Retention

Each criterion is discussed in detail in the *Interim Rules of Development for Individual Single-Family Lots* in Part 8, Volume 2, Section 3. Recommendations are made for selection of specific measures or requirements for each tool or criteria for the ADMP.

Phase II Development Guidelines – The Interim Rules of Development were further refined in Phase II of the ADMP and are presented as the Development Guidelines for Individual Single-Family Lots in Part 8, Volume 4, Section 2. Due to the uncertainty of implementation protocols brought about by the recent transition of regulatory authority for Title 11 Drainage Ordinance to the Maricopa County Planning & Development Department, final implementation strategies for the Development Guidelines are pending and will be determined in the future.

SECTION 5: PHASE II ALTERNATIVES ANALYSIS

The alternatives formulation process is presented in Figure 3.1. The work plan consists of four major components; including Problem Identification, Measures (Solutions), Preliminary Alternatives, and Recommended Alternative. As described in Section 3, the work tasks comprising Phase I addressed problem identification, brainstorming measures (solutions), and alternatives evaluation with the resultant outcome of four Phase I Preliminary Alternatives to be considered for further refinement during Phase II. The end product of Phase II is the Recommended Alternative. The following sections describe the Phase II preliminary alternatives that were carried forward from the Phase I alternative formulation process and the preliminary analysis that leads to the recommended alternative for the Adobe ADMP. Table 5.1 summarizes the Phase I preliminary alternatives that were carried forward, becoming the Phase II preliminary alternatives.

5.1 Problem Description, Alternatives, And Environmental Summary By Site Number

Site Number 1

Problem Description – In June of 1993 Wood/ Patel contracted with the City of Phoenix to perform an analysis of alternatives for design options of a bridge over Skunk Creek at Pinnacle Peak Road. This report, *Phase 1, Design Option Report Pinnacle Peak Road Bridge Over Skunk Creek, BR-922765,* Performed by Wood/ Patel Associates in June, 1993, looked at several options for bridges. From this report, the recommended alternative was Option C-1 which provided a 100-year crossing at Pinnacle Peak Road and allowed for future extension of 35th Avenue to the north. In addition, its channel geometry provided a sediment transport rate comparable to the existing channelization to the north.

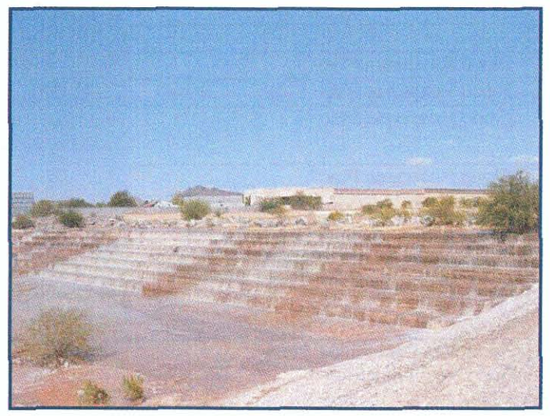


Figure5.1 Skunk Creek Drop Structure (9-20-04)

Even though this alternative was recommended, what was actually built in 1995 was a four-span concrete box-girder bridge, a roller-compacted concrete drop structure (Figure 5.1) located approximately 350 feet upstream of the bridge, and an excavated channel with soil-cement bank protection between the drop structure and the bridge. The excavated channel has a bottom width of 250 feet and continues, unlined, downstream of the bridge to the Adobe Dam reservoir area. After conversations with Phoenix and Wood/ Patel, it appears that the reason for downgrading the construction from the recommended alternative was because of budgetary reasons. It was felt that it was better to build something that protected most of the time and improve it later when funds or cost sharing partners were available.

In 2002 Tetra Tech, Inc. completed the *Letter of Map Revision Request for Skunk Creek, City of Phoenix Contract No. SA-930222, Technical Data Notebook.* This report identified a breakout from Skunk downstream of the landfills and upstream of the drop structure across Pinnacle Peak Road. Also in 2002, Coe & Van Loo Consultants performed the *Split Flow Analysis Over Pinnacle Peak Road, CVL #98-0013.* This report addressed this breakout from Skunk Creek and extended the effects of the breakout downstream through the park and back into the Adobe Dam reservoir impoundment area. This split flow analysis assumed that the entire 15,500 cfs breakout crossed Pinnacle Peak Road and entered the park site. Because of this breakout, the ADMP looked at this site and what could be done to eliminate future breakouts and deliver the flows to the Adobe Dam reservoir area.

Alternatives – The four alternatives for all of the sites consist of a full structural, non-structural, no action and combination alternative. The combination alternative for each site consists of elements taken from each of the other three alternatives and is site specific.

For Site Number 1 the full structural alternative consists of a concrete stepped drop structure immediately downstream of the southern boundary of the Skunk Creek Landfill, a levee between the drop structure and landfill, and an incised channel downstream of the drop structure. The cross-sectional geometry of the channel is a trapezoid with 2:1 side slopes. The drop structure is a stepped concrete structure with eight 2-foot high steps to dissipate energy. The levees will be keyed into the existing levee system for the landfill. All channel embankment lining consists of soil cement. The freeboard allowance for the 100-year flow condition is 1.5 feet. Comparisons of the 100-year water surface elevations of this option with those of the revised CVL model shows that the water surface does not increase at any cross sections. This alternative is consistent with Option C-1 as presented in the *Phase 1, Design Option Report Pinnacle Peak Road Bridge Over Skunk Creek, BR-922765,* performed by Wood/Patel Associates in June, 1993.

The non-structural alternative at Site Number 1 is the Flood Response Plan (FRP). The FRP would alert first responders to the area when flood levels are such that emergency action or measures, such as barricading, is necessary.

The combination alternative, like its name, combines the full structural alternative with the non-structural FRP. By constructing the structural fixes and then incorporating the FRP, Site Number 1 maximizes the public safety in the area of 35th Avenue and Pinnacle Peak Road.

Table 5.1 Adobe Dam/ Desert Hills Area Drainage Master Plan Phase I Preliminary Alternatives

Problem Site Identification	Phase II Site Number	Full Structural Alternative	Non-Structural Alternative	Combination Alternative	No Action Alternative
Phoenix South of CAP					
PSC1 - Skunk Creek/ Pinnacle Peak Rd & 35th Ave	Site Number 1	PSC1A - Levees/ grade control	Flood Response Plan (FRP)	Channelization/ grade control and Flood Response Plan	PSC1B
PSC2 - Skunk Creek d/s of CAP	Site Number 2	PSC2A - Levees	PSC2B - Floodplain Delineation	PSC2A – Levees followed by PSC2B Floodplain Re-Delineation	PSC2C
Phoenix North of CAP					
PNC3 - Skunk Creek u/s of CAP	Site Number 2	PNC3A - Basins (Meter) **OR** PNC3B - Widen overchutes (Flume) **OR** PNC3C - Levees		PNC3C – Levees	PNC3D
Desert Hills					
DH4 - Skunk Creek/ 27th Ave & Cloud Rd	Site Number 3	DH4A - Roadway realignment **OR** DH4B - Roadway realignment w/ Freeboard **OR** DH4C - Bridge **OR** DH4D - Protection of existing alignment	Flood Response Plan	DH4A – Roadway realignment w/ Flood Response Plan	DH4E
DH5 - Skunk Tank Wash (STW)	Site Number 4	DH5B - Interceptor channel/ basin **OR** DH5C - Online basin	DH5A - Revised STW hydrology Floodprone Property Acquisition Program Flood Response Plan	Floodprone Property Acquisition Program (FPAP) Flood Response Plan Joy Ranch Road Interceptor upstream detention basin	DH5D
DH6 - Desert Lake (ASLD parcel)	Site Number 5	DH6A - Skunk Tank Wash, ASLD detention basin	DH6B - Floodplain Delineation	DH7C – Basin on ASLD parcel/ channelization and DH8A – 100-yr Channel/ Culverts @ 7th St followed by Floodplain Re-Delineation Development Guidelines	DH6C
DH7 - Desert Lake Wash d/s of Cloud Rd	Site Number 5	DH7A - Pre-ASLD parcel development **OR** DH7B - W/ ASLD parcel development **OR** DH7C - Basin on ASLD parcel			DH7D
DH8 - E fork Desert Lake Wash/ 7th St	Site Number 5	DH8A - 100-yr Channel/ Culverts @ 7th St			DH8B
DH9 - Desert Hills Wash/ Cloud Rd & 12th St	Site Number 12	DH9A - Channel/ Culvert/ Offline basin	Flood Response Plan	DH9B – No Action/ Flood Response Plan	DH9B
DH10 - Carefree Highway/ Central Ave to E of 24th St	Site Number 6	DH10A - Culverts	Flood Response Plan	Flood Response Plan/ DH10A – Culverts	DH10B
DH11 - Apache Wash/ 24th St	Site Number 7	DH11A - Realign roadway **OR** DH11B - Channel/ Culverts	Flood Response Plan	Flood Response Plan/ DH11A – Realign roadway	DH11C
DH12 - Desert Hills Wash/ Joy Ranch Rd & 16th St	Site Number N/A	DH12A - Culvert **OR** DH12B - Culvert/ Channel	Flood Response Plan	DH12C – No Action/ Flood Response Plan	DH12C
DH13 - Skunk Creek/ Desert Hills Drive	Site Number 8	DH13A - Bridge	Flood Response Plan	Flood Response Plan/ DH13A – Bridge	DH13B
New River					
NR14 - Roger Creek/ New River Rd	Site Number 9	NR14A - Bridge **OR** NR14B - Culverts	Flood Response Plan	Flood Response Plan/ NR14A – Bridge	NR14C
NR15 - Cline Creek/ Circle Mountain Rd	Site Number 10	NR15A - Riprap bank protection **OR** NR15B - Gabion bank protection **OR** NR15C - Shotcrete bank protection **OR** NR15D - Terraced wall w/naturalized treatment	Floodplain Delineation Study Flood Response Plan	Flood Response Plan/ NR15D – Terraced wall w/ naturalized treatment Floodplain Delineation Study	NR15E
NR16 - Skunk Creek/ New River Rd Bridge	Site Number 11	NR16A – Levees/ Channel improvements **OR** NR16B - Secondary diversion channel **OR** NR16C - Channel improvements at bridge	Floodplain Delineation Study Flood Response Plan	NR16A – Levees/ Channel improvements followed by Floodplain Re-Delineation	NR16D

The no action alternative would have the effect of allowing the breakout of 15,500 cfs to continue to cross Pinnacle Peak Road in the 100-year event. Without the FRP, emergency response and barricading of Pinnacle Peak would be significantly hampered.

Environmental – LSD provided an environmental summary for Site Number 1. There is an opportunity for improvement of the moderate habitat located around this site. Numerous hazardous materials concerns are located within the area of Site Number 1. However, only illegal dumping is present at the site itself. The opportunity for improvement of the visual character exists especially next to the landfill and Skunk Creek (Figure 5.2). Currently this area is in bad visual shape. Multiuse opportunities exist in the form of a proposed trail system along Skunk Creek. The trail system could create links to nearby Adobe Dam Recreation Area, Thunderbird Park, and Paseo Highland Park.

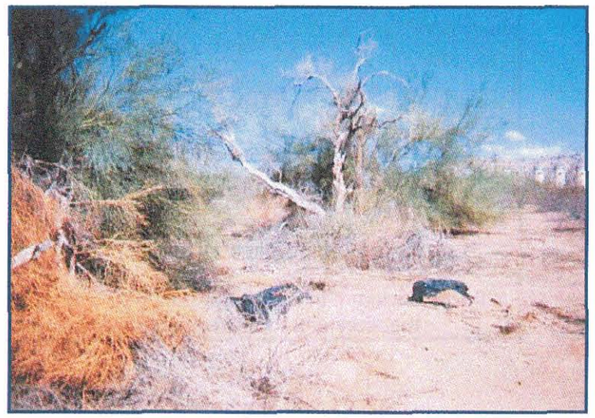


Figure 5.2 Illegal Dumping in Skunk Creek.

Site Number 2

Problem Description – In 1990, Coe & Van Loo used HEC-2 to estimate the 100-year floodplain limits for Skunk Creek upstream of the Central Arizona Project Canal (CAP) and to estimate the amount of discharge that breaks away from Skunk Creek in the effective Flood Insurance Study. Their findings were as follows:

- Approximately 3,000 cfs breaks out to the west across I-17.
- Approximately 5,000 cfs breaks out to the south into the CAP Canal on the west side of the Skunk Creek Overchute.
- Approximately 1,000 cfs breaks out to the south into the CAP Canal on the east side of the Skunk Creek Overchute.
- Approximately 1,000 cfs breaks out to the south into the CAP Canal on the west side of the Sonoran Wash Overchute.
- Approximately 200 cfs breaks out south into the CAP Canal on the east side of the Sonoran Wash Overchute.
- Approximately 16,600 cfs continues down the Skunk Creek channel corridor.

In 1997 Montgomery –Watson accepted the Coe & Van Loo study for the *Skunk Creek Floodplain Delineation Study.*

In 2001 Tetra Tech, Inc. performed the Skunk Creek Watercourse Master plan (WCMP) and identified flooding across I-17 upstream of the CAP. This flooding is summarized in the *Skunk Creek Watercourse Master Plan, Attachment 7, Two Dimensional Hydraulic Model of the Confluence of Skunk Creek & Sonoran Wash at the CAP Canal, FCD 99-23.* This attachment was added to the Watercourse Master Plan because of the complex problem of a very broad floodplain in the confluence area in combination with the structures associated with the CAP. The FCDMC was interested in better defining the following:

- The 100-year water surface elevations, limits of flooding, and flow patterns upstream and downstream of the CAP.
- The location and magnitude of flow that would break out of the Skunk Creek/Sonoran Wash corridors during the 100-year flood event.
- The associated hydraulic parameters associated with the 100-year event such as depths, velocities, etc...
- The location and type of hydraulic controls.
- The modifications needed to contain the 100-year event within the Skunk Creek/Sonoran Wash corridors.
- The ability of the CAP overchute structures to accommodate the 100-year event.
- The impact of the two dimensional analysis results on the starting water surface elevations specified in the existing FIS studies on Skunk Creek and the initial FIS study for Sonoran Wash.
- The recurrence interval of the initial breakout flow across I-17.

The following is a summary of the results found in this initial two dimensional modeling:

- The 100-year starting water surface elevation for Skunk Creek was estimated at 1533.7 by two dimensional modeling which compares to a starting water surface elevation of 1532.5

that was used for both the effective FEMA study and the Tramonto Conditional Letter of Map Revision (CLOMR).

- The 100-year starting water surface elevation for Sonoran Wash was established as 1532.1.
- The breakout flow across I-17 is 6,400 cfs, has an average depth of 2.5 feet, and a total volume of 76,800 acre feet.
- The overchute structures are capable of passing the combined 100-year event from Skunk Creek and Sonoran Wash assuming that flow is directed to them by raising the upstream embankment so that the design flow is actually 100-year instead of 50-year. However, the extent of local scour upstream and downstream of the structures was not evaluated. These results assumed that ponding behind the proposed levee improvements upstream of the CAP are allowed to occur.
- The earliest breakout flow was noted to be 14.20 hours at I-17. This corresponds to a total discharge of approximately 17,600 cfs on the Skunk Creek Hydrograph which also corresponds to approximately a 26-year recurrence interval on the discharge frequency curve.
- Table 5.2 shows the comparison of this study with the Coe & Van Loo study with respect to breakout locations and magnitude.
- Table 5.3 is a summarization of levees that were modeled in this report to contain the flows.

Table 5.2

WCMP Comparison of Breakout Flows for Site Number 2

Location	100-Year Breakout Discharge (cfs)	Coe & Van Loo 100-Year Breakout Discharge (cfs)
West of the Skunk Creek Overchute	1,100	5,000
Across I-17	6,400	3,000
East of the Skunk Creek Overchute	500	1,000
West of the Sonoran Wash Overchute	2,500	1,000
East of the Sonoran Wash Overchute	1,200	200
Flow to the Southeast along the CAP.	100	Not Reported

Table 5.2

WCMP Comparison of Breakout Flows for Site Number 2

Location	100-Year Breakout Discharge (cfs)	Coe & Van Loo 100-Year Breakout Discharge (cfs)
Overchutes		
Skunk Creek	18,500	*16,600
Sonoran Wash	6,100	*16,600
Total	36,400	26,800
Reported total in Report	36,400	35,000
*It was unclear if these are for both overchutes together or individually. It was assumed that they are combined since they are different size hydraulic structures.		

Table 5.3

WCMP Levee Design for Site Number 2

Location Description	Length of Levee (feet)	Estimated Height (feet)	Quantity of Fill (20' Average Width) (cu yd)
From Skunk Creek Overchute, 1800' west	1,800	5	8,000
From the end of previous levee, 500' north	500	4	2,000
East side of Skunk Creek Overchute	500	5	2,300
West side of Sonoran Wash Overchute	200	4	1,000
East side of Sonoran Wash Overchute	300	4.5	1,500
East side of study area, upstream of the CAP	300	7	1,600
East side of Study area upstream of the CAP	300	4	900

One of the outcomes of the WCMP was the recommendation that the two dimensional modeling be extended to include Buchanan Wash to the west and extend downstream to Happy Valley Road. In 2002, The FCDMC contracted with Tetra Tech, Inc. to perform this modeling. As a result of this, the *Floodplain Delineation Study for Skunk Creek Between the Central Arizona Project and Happy Valley Road, Two-Dimensional Hydraulic Model* was performed. This study expanded on the previous studies and includes the following analyses for both the 100-year and Standard Project Flood (SPF) events:

- An expanded two dimensional analysis of existing conditions. The Skunk Creek study limits are from Happy Valley Road (downstream limit) to the CAP. Buchanan Wash, from the CAP to its confluence with Skunk Creek, is also included in the study area.
- A floodplain analysis for the area west of I-17.
- Two pre-development condition models; one without the CAP and another without I-17 or the CAP.
- An analysis of widening the CAP overchutes as a possible remedial alternative.
- An analysis of extending the existing levee system to contain breakout flows.

The results from this study are as follows:

- The existing condition model confirmed breakouts north of the CAP over I-17 in both the 100-year and SPF flood events. The 100-year breakout goes over the canal and ponds on the north side of the CAP and in the medians.
- The existing condition model showed that significant ponding occurs north of the CAP on Buchanan Wash. This ponding causes significant attenuation in the model that is not accounted for in the effective FIS hydrologic model. The land in the ponding area is presently owned by the State of Arizona.
- The predevelopment models show that the flows were fairly well contained only after I-17 was built. The addition of the CAP only helped to contain the flows within the system.
- Widening the overchutes does not help to alleviate the flooding problems within the system. Flow still breaks out over I-17 north of the CAP.
- Extending the levees upstream from the current location to the CAP, and north of the canal, on both the east and west sides effectively confines the flows in the channel corridor during the 100-year event. During the SPF event, there is some backwater leaving the channel through the opening between the Corp of Engineers (Corp) levees and the City of Phoenix landfill levees. The costs of these levees are summarized in Tables 5.4 and 5.5.

Table 5.4

2D Report Levee Cost Estimates for Site Number 2 (Soil Alluvium Toe-Down)

Location	Height (feet)			Length (Feet)	Avg. End Area (sq ft)		Volume (cu yd)		Construction Cost		
	High	Low	Avg.		Levee	Toe-Down	Levee	Toe-Down	Levee	Toe-Down	Total
East bank from existing levee to CAP	6	2	3.3	4,600	78	135	13,289	23,000	$0.83M	$1.44M	$2.27M
East bank from CAP to end	12	3	6.6	1,200	251	135	11,156	6,100	$0.70M	$0.38M	$1.07M
West bank from existing levee to CAP	6	1	3.1	3,000	85	135	9,444	15,000	$0.59M	$0.94M	$1.53M
West bank from CAP to end	7	1	3.8	2,000	89	135	6,593	10,000	$0.41M	$0.63M	$1.04M
Total									$2.53M	$3.38M	$5.91M
*Construction cost = $62.50 per cubic yard, per FCDMC.											

Table 5.5

2D Report Levee Cost Estimates for Site Number 2 (Concrete Toe-Down)

Location	*Construction Cost		
	Levee	Toe-Down	Total
East bank from existing levee to CAP	$830,600	$480,700	$1,311,300
East bank from CAP to end	$697,300	$125,400	$822,700
West bank from existing levee to CAP	$590,300	$313,500	$903,800
West bank from CAP to end	$412,100	$209,000	$621,100
Total	$2,530,300	$1,128,600	$3,659,000
*Construction cost = $62.50 per cubic yard for Cement Soil Alluvium (levee), per FCDMC. $94 per cubic yard for concrete (toe-down), per CalTrans Construction Cost Index.			

The ADMP was tasked with formulating alternatives that would solve the flooding across I-17 as well as the flooding that would occur upstream of the Corps of Engineers levees. The Corps of Engineers levees are upstream of the crossing of Skunk Creek and I-17. These levees, however, do not extend to the CAP. The aforementioned modeling shows that the 100-year flow backs up in the levee area and "end runs" the levees to both the east and west. New development currently exists to the east and established businesses and residences exist to the west between I-17 and the back side of the Corps. of Engineer's levees.

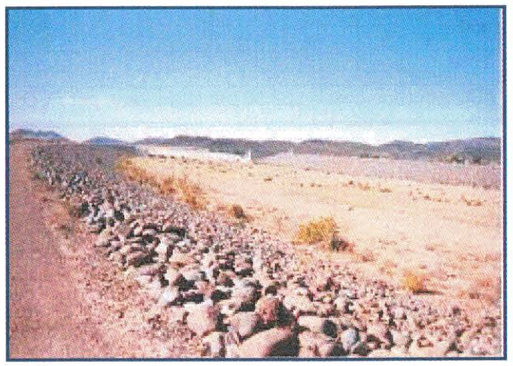


Figure 5.3 The Corps of Engineers Levees in Skunk Creek

Alternatives – For Site Number 2 the full structural alternative consists of extending the Corp levees (Figure 5.3) north until they tie into the CAP (4,600 feet from the east bank to the CAP and 3,000 feet from the west bank to the CAP). Additionally, a levee north of the CAP along I-17 is recommended (approximately 2,000 feet of levee) to stop overtopping of the I-17. Refer to Table 5.4 for approximate lengths of levee extensions.

The non-structural alternative at Site Number 2 is new Floodplain Delineation Studies (FDS) on Skunk Creek south of the CAP canal and north of the existing Corps of Engineers Levee. The FDS will accurately depict the flood hazard in the study area, specifically the area between Skunk Creek and I-17, so that further construction within the area does not encroach into the high hazard areas. Furthermore, these new FDS studies will allow regulators to better understand where the existing structures are in relation to the actual hazard.

The combination alternative combines the full structural alternative with the non-structural FDS. By constructing the structural fixes and then incorporating new FDS studies for re-delineation, the new flood zones will be known and existing structures can be removed from the flood hazard zones.

The no action alternative would have the effect of allowing the breakout of 6,400 cfs to continue to cross I-17 in the 27-year event. The flows will continue to "end run" the existing Corp levees and the current flood hazare will remain undefined.

Environmental – LSD provided an environmental summary for Site Number 2. There is intact xeroriparian habitat present at Site Number 2; in survey zone 3 for cactus ferruginous pygmy-owl (CFPO). Any improvements made at Site Number 2 will be visible from the I-17 and the CAP canal, making the visual design extremely important. Site Number 2 is also the site of a link between the regional multiuse trail along the CAP and Skunk Creek.

Site Number 3

Problem Description – During the process of identifying problem areas within the ADMP study area, the ADMP team noticed that where Cloud Road bends north and transitions into 27th avenue (Figure 5.4), the existing alignment is located within the 100-year floodway of Skunk Creek. The ADMP team identified this site because of two major reasons. One, the high hazard potential of the roadway "washing out" would create a major public safety hazard and two; access north could be completely cut off due to the fact that the only other access to this area, at Skunk Creek and Desert Hills Drive, is a low water crossing.

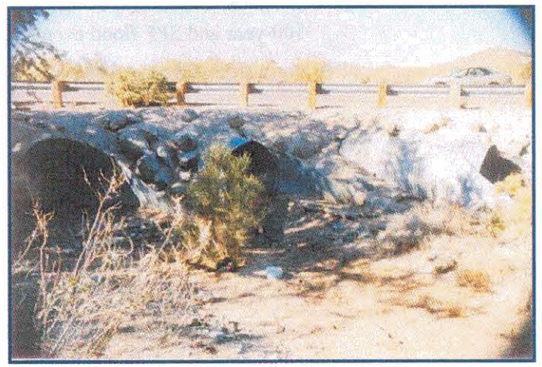


Figure 5.4 Skunk Creek Crossing at 27th Avenue

Alternatives –Four structural alternatives were considered for site number 3. Each alternative was analyzed using the Flood Insurance Study (FIS) models established by Montgomery Watson in 1997 for Skunk Creek. The 100-year FIS flow that was used for design at Site Number 3 is 27,700 cfs.

The first alternative was to realign the existing roadway so that it was outside of the floodway. This alternative would be an all weather access with a raised roadway embankment above the 100-year base flood elevation. The embankment would be protected.

This alternative would remove approximately 12 acres from the floodplain, but would require the "taking" of private property for right-of-way. The roadway would not be built to accommodate FEMA freeboard requirements and could cause potentially higher noise levels to existing homeowners due to the roadway being closer to the residences. This alternative also included the removal of the existing roadway so that the floodway could be opened up.

The second alternative was exactly the same as the first one with the exception being that the roadway is raised to accommodate the Federal Emergency Management Agency (FEMA) freeboard requirements. This would allow for redelineation of the floodplain so that structures currently considered in the floodplain could officially be removed altogether.

The third alternative was to build a bridge structure the entire length of the floodplain along the existing roadway alignment. This alternative would not require the acquisition of more right-of-way, but would require much higher construction costs. This alternative would not remove any existing structures from the floodplain.

The final alternative at Site Number 3 was to construct floodwalls and erosion protection to protect the existing roadway alignment. This alternative would also not require any right-of-way costs, but because of the high velocities in the area, would require high construction costs. No existing structures are removed from the floodplain with this option. Reconstruction of the floodwalls and erosion protection is very likely due to the high probability of "washouts".

The ADMP team looked at these alternatives and decided that the preferred alternative was the Roadway realignment referred to in Table 5.1 as DH4A. This decision was based on the fact that it addresses the public safety issue as well as providing access to the northern area with the lowest current and future costs associated with it. This measure cost less than the other measures to implement and maintain. It also has a higher benefit cost ratio and has more public and agency support.

The non-structural alternative at Site Number 3 is the Flood Response Plan (FRP). The FRP would alert first responders to the area when flood levels are such that emergency action or measures, such as barricading, is necessary. This is critical in this area due to the access problem that would be created to the area north if Site Number 3 is not addressed.

The combination alternative combines the full structural alternative with the non-structural FRP. By constructing the structural fixes and then incorporating the FRP, Site Number 3 maximizes the public safety in the area of Cloud and 27th Avenue. It also allows an all weather access north.

A no action alternative would have the effect of creating a situation where the probability is high that access north along 27th Avenue would be cut off due to a "wash out" at Site Number 3. This may not be so important, if access is addressed in this area at Site Number 8 (Desert Hills Drive and Skunk Creek). However, one of these two sites needs to be addressed for access so that emergency services can get into this area if flooding occurs.

Environmental – LSD provided an environmental summary for Site Number 3. A chance exists to restore habitat in Skunk Creek in this area. By removing the roadway from the riparian corridor, habitat can be restored. There is intact xeroriparian habitat present at Site Number 3; in survey zone 3 for CFPO. It is important to link to existing multiuse paths and recreational facilities in Tramanto developments at Site Number 3.

Site Number 4

Problem Description – Site Number 4 was identified by the ADMP team during the process of problem identification. The hydrology in this area showed that there is a flow breakout that occurs from Desert Lake Wash that was not accounted for in the Skunk Tank Wash Hydrology. JEF performed a FLO-2D analysis in the area and addressed exactly what the flow within the area is doing. Refer to Part 3, Volume 2 for the results of the FLO-2D analysis. Flow in this area floods existing structures and inundates the roadway system. More specifically, the flow that crosses Joy Ranch Road and flows across the State Land Parcel currently intersects 7th Avenue between Joy Ranch Road and Cloud Road. It then continues west into Skunk Tank Wash, flooding several structures along the way. At the Skunk Tank Wash Confluence the flow combines with the Skunk Tank Wash flows coming from the north. The combined flow then continues west until it dumps into Skunk Creek.

The main issues with this site is to lower the peak discharge to a level that would protect the residences in danger and to manage the flow in such a way that it can be conveyed through the system so that it does not inundate the roadway system or spread into inhabited properties.

Alternatives – Design flows for this site came from a HEC-1 model performed by JEF that was built as described in Part 8, Volume 4. Once the hydrology was finalized, the ADMP team looked at a full structural alternative that would intercept the overland flow prior to the overtopping of 7th Avenue between Joy Ranch Road and Lavitt Lane and convey it under three driveway accesses and eventually under Joy Ranch Road. The interceptor

channel would then continue from Joy Ranch Road parallel to 7th Avenue for approximately 3,400 feet where it would turn 90 degrees to the west and convey the flow under 7th Avenue into a culvert crossing. At this location the flow will need to be reduced so that it is a manageable level continuing through the rest of the channel system. This is accomplished by diverting the flow through an offline detention basin. This basin will require 60 acre-feet of volume to function correctly. The basin depicted within the context of this report was designed to be 10 feet deep. The control/spillway structure will require a design that allows all but 420 cfs of inflow hydrograph to enter into the basin.

The channel leaving the basin will convey the reduced peak discharge from 7th Avenue to 11th Avenue (Figure 5.5) where it will convey through another culvert crossing. At this point a channel will then continue from 11th Avenue to 15th Avenue where it will convey under the roadway. The channel will then continue west until it converges with flow that is coming from the north.

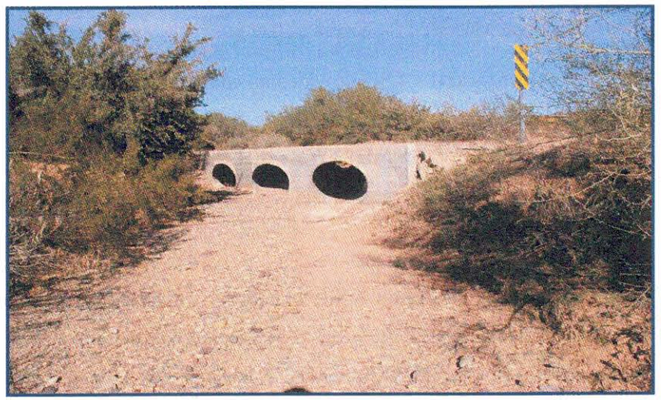


Figure 5.5 Skunk Tank Wash and Cloud Road/11th Avenue

Flow coming from the north in what is designated as Skunk Tank Wash enters an online detention basin. This basin will require 71 acre-feet of volume to function correctly. The basin depicted within the context of this report was designed to be 10 feet below the natural grade of Maddock Road which serves as the outlet. The outlet at Maddock Road is designed for 2,150 cfs and establishes a rating curve for the next basin downstream. The upper basin does not, however, reduce the peak enough as to make it manageable downstream. Therefore, an offline basin is necessary to reduce the peak to a manageable level. This basin will require 65 acre-feet of volume to function correctly. The basin depicted within the context of this report was designed at 15 feet deep. The control/spillway structure will require a design that allows all but 1,100 cfs of inflow hydrograph to enter into the basin.

The channel leaving the last basin will take the flow not entering the detention basin and convey it from Maddock Road to the confluence with the channel discussed earlier. The combined channels will then convey the flow from the confluence to just west of 19th Avenue. Crossings at both 17th Avenue and 19th Avenue are proposed to be ford crossings on grade. This last channel is also proposed to be a regrade of the existing wash so that the intent of the design is to provide bank-full capacity for something less than the 100-year flow, with the full 100-year flow being conveyed in a "floodway" (encroached) section that surcharges the channel by less than 1 foot.

The channels for Site Number 4 were designed using normal depth calculations and using the FlowMaster program distributed by Haestad Methods. The roadway crossings were designed using the HY8 computer program as distributed by the University of Florida, McTrans Center for Microcomputers in Transportation. FlowMaster output, HY8 printouts, and basin design calculations can also be found in Part 8, Volume 4.

This alternative combines the measures indicated in Phase I into an alternative that makes sense structurally. This alternative remedies many of the flooding issues which occur along 7th Avenue, and the east branch of Skunk Tank Wash. It handles the breakout flows and the flooding onto 7th Avenue by providing an all weather access crossing. However, it does not help two floodway residences upstream of the confluence in Skunk Tank Wash and may not completely remove the flood hazard downstream of the confluence due to how low the floodway residences are in the wash bottom. This is an expensive alternative that will require extensive maintenance within the flood structures themselves.

The non-structural alternative consisted of several parts; revisions to the Skunk Tank Wash hydrology so that actual peak discharges reflect the latest hydrology, the Floodprone Property Acquisition Program (FPAP) to remove residences from floodprone areas, and the FRP so that proper emergency response occurs in the area.

The combination alternative combines the FPAP with the FRP. It also incorporates an interceptor channel along the south edge of Joy Ranch Road between 7th Avenue and 7th Street tied to a detention basin on the northern boundary of the Arizona State Land Department trust parcel that would meter the flows south toward Cloud Road.

The no action alternative would have the effect of allowing flooding to continue to occur in the manner in which it currently does. Roadway closures at 7th, 11th, 15th, 17th, and 19th Avenues would continue occurring at a frequent rate. Residences located in floodprone areas would continue to be inundated in events less than the 100-year event.

Environmental – LSD provided an environmental summary for Site Number 4. Drainage structures added in residential areas could be made wildlife-friendly and could help restore smaller wash connectivity. This site is located in survey zone 3 for CFPO. A few storage tanks at convenience stores and farms are present within the area. Drainage structures constructed in this area would need to be visually compatible with nearby residences. The visual character in this area is mostly "rural ranch residential" with numerous equine facilities. Little consistency exists in the area with regard to material, style, or color.

Site Number 5

Problem Description – Site Number 5 was identified by the ADMP team during the process of problem identification. Overland flow coming from the north either uses 7th Street from Saddle Mountain Road to Cloud Road

as a flow corridor or it crosses 7th street around Desert Hills Drive and flows south through a developed area until it intersects Joy Ranch Road where it crosses and continues across the ASLD parcel to Cloud Road. Flooding of structures and the roadway system do occur north of Joy Ranch Road, but becomes a real concern once it reaches Cloud Road. The flow that comes down the right-of-way of 7th Street turns in a southwesterly direction and sheet flows across a developed area before it enters Desert Lake Wash again west of 3rd Street. The flow coming down Desert Lake Wash continues south of Cloud Road inundating several floodway resident structures, combining with the flow from 7th street, and continuing southeast back to 7th Street and eventually past the Carefree Highway toward Cave Creek.

The main issues with this site are to confine the flows from the north in such a manner as to convey them through the area without flooding the roads or any of the existing structures. Removal of structures from the floodway is also an important aspect of this site.

Alternatives – Design flows for this site came from a HEC-1 model performed by JEF that was built as described in Part 8, Volume 4. Site Number 5 began as several individual sites that were somewhat tied into the same system. The full structural alternative at Site Number 5 is detailed as flow coming from the north is intercepted in a channel that parallels 7th Street from Irvine Street to Joy Ranch Road. One Culvert would need to be constructed for access within this stretch of channel. Once the flow gets to Joy Ranch Road, it is necessary to convey the flow from the northeast corner of the intersection to the southwest corner of the intersection. This would be done in a culvert that would outlet onto the ASLD parcel.

Once the flow crosses the intersection of 7th Street and Joy Ranch Road, it continues parallel to Joy Ranch Road for approximately 1,300 feet. This Channel has three functions; 1) to convey flow to the channel which flows south to below Cloud Road; 2) to intercept flow crossing Joy Ranch Road from the north out of the developed area; 3) to function as an inlet weir section to the offline detention basin located in the northeastern corner of the ASLD parcel. The ultimate channel design will be a function of the amount of flow spilled to the basin which JEF estimates at 250 cfs.

The detention basin is designed with a required volume of 40 acre-feet to make it function correctly. For the graphical context of this report, JEF designed the basin at 5 feet deep. This basin will require a control/spillway structure to allow all but 250cfs of inflow hydrograph into the basin.

After the peak has been reduced by the detention basin, a channel will be constructed that will flow south to Cloud Road (Figure 5.6) where it will be conveyed under the Roadway by a culvert. Flow will then continue down to Leisure Lane where it will flow under the roadway in another culvert.

South of Leisure Lane, the flow will be conveyed in a channel until approximately 250 feet south of 3rd Street. The flow will also cross Galvin Street and 3rd Street in culverts. The channel from Restin Road to 7th Street is to be a regrade of the existing wash to a section the intent of which is to provide a bank-full capacity for something less than the 100-year flow (approximately 1,100 cfs), with the full 100-year flow being conveyed in a floodway (encroached section) that surcharges the channel by one foot.

The channels for Site Number 5 were designed using normal depth calculations and using the FlowMaster program distributed by Haestad Methods. The roadway crossings were designed using the HY8 computer program as distributed by the University of Florida, McTrans Center for Microcomputers in Transportation. FlowMaster output, HY8 printouts, and basin design calculations can also be found in Part 8, Volume 4.

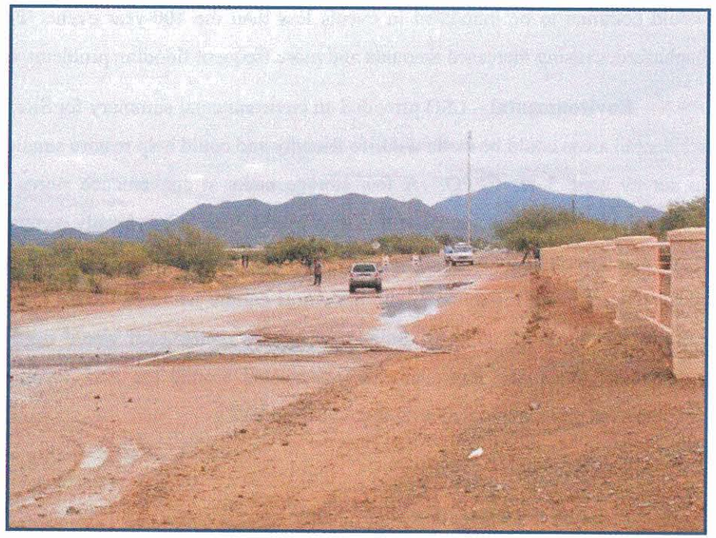


Figure 5.6 Desert Lake Wash Flooding at Cloud Road (10-10-03)

This alternative remedies many of the flooding issues happening along 7th Street and south of Cloud Road. It removes most of the floodplain inundated residences and all of the floodway residences. However, the cost is very high and has a low benefit/cost ratio. Maintenance of the designed system is also very expensive.

The non-structural alternative consisted of several parts; new floodplain delineations that reflect the actual flood hazards in the area, the Floodprone Property Acquisition Program (FPAP) to remove residences from floodprone areas, new development guidelines to help control the type of development that happens in the future within the area, and the FRP so that proper emergency response occurs in the area.

The combination alternative combines structural channel work upstream of Joy Ranch Road, the offline detention basin located on the ASLD parcel, a channel continuing from the detention basin down to Cloud Road where a roadway crossing would be constructed, the FPAP program south of Cloud Road for floodprone residences,

the FRP for proper emergency response, floodplain redelineation following construction of structural measures to more accurately portray the flood hazard, and new development guidelines to help control the type of development that happens within the area.

The no action alternative would have the effect of allowing flooding to continue to occur in the manner in which it currently does. Roadway closures at 7th Street, Joy Ranch Road, Cloud Road, Restin Road, Galvin Street, Central Avenue, and 3rd Street would continue occurring at a frequent rate. Residences located in floodprone areas would continue to be inundated in events less than the 100-year event. Finally, development will continue to be haphazard, causing increased amounts and more frequent flooding problems within the area.

Environmental – LSD provided an environmental summary for Site Number 5. Drainage structures added in residential areas could be made wildlife-friendly and could help restore smaller wash connectivity. This site is located in survey zone 3 for CFPO. A few storage tanks at convenience stores and farms are present within the area. Drainage structures constructed in this area would need to be visually compatible with nearby residences. Any trails constructed need to tie to open space at the Desert Mountain Middle School. The visual character in this area is mostly "rural ranch residential" with numerous equine facilities. Little consistency exists in the area with regard to material, style, or color. Any drainage structures constructed would need to be visually compatible with nearby residences. Also, any improvements constructed around the ASLD parcel would be very visible in regards to development plans associated with the ASLD parcel.

Site Number 6

Problem Description – While analyzing the alternatives in the Desert Hills area, it was observed that many of the roadway crossings associated with the Carefree Highway were undersized when analyzed with the 100-year recurrence interval storm. Therefore, Site Number 6 was identified by the ADMP team as an area of concern. The probable impassable crossings along the Carefree Highway are at Desert Lake Wash, Desert Hills Wash, Apache Wash (Figure 5.7), the West Branch of Paradise Wash and Paradise Wash itself.

Figure 5.7 Apache Wash Crossing at the Carefree Highway (1-9-03)

In addition to impassable crossings in the 100-year event, it was also identified in the FLO-2D analysis that flow running along the south side of the Carefree Highway between 3rd Avenue and the crossing of Desert Lake Wash is confined into a channel that does not contain the 100-year event. The channel and driveway access crossings are under-sized.

The main issues with this site are to confine the flows in the existing washes by upgrading the roadway crossings as well as the channel between 3rd Avenue and the Desert Lake Wash Crossing so that it is confined within the channel.

Alternatives –Design flows for this site came from two sources that are actually combined into one source. The flow from the south for sizing the channel came from the FLO-2D analysis discussed earlier. The culvert crossing discharges came from the Desert Hills Area Hydrology completed by JEF as part of the ADMP or more specifically combined together in Part 3, Volumes 1 and 2.

The full structural alternative consists of a concrete channel constructed between 3rd Avenue and the Desert Lake Wash crossing of the Carefree Highway. The channel is designed based on FlowMaster calculations and the two-dimensional analysis performed by FLO-2D. The hydraulic specifics were done as a part of Part 8, Volume 2, Section 4 of the ADMP entitled *Roadway Drainage Crossings Passability* . The hydraulic details and the FlowMaster details are located in Part 8, Volume 4, Section 1. Along with the channel, upgraded roadway crossings would be constructed at Desert Lake Wash, Desert Hills Wash, Apache Wash, the West Branch of Paradise Wash and Paradise Wash to a level of 100-year. This alternative reduces the flooding associated with roadway crossings and allows for 100-year flows to pass under the Carefree Highway.

The non-structural alternative for Site Number 6 is the FRP. The FRP will allow for proper emergency response to flooding within the site area.

The combination alternative combines the full structural alternative, so that the 100-year flooding event can be conveyed south of the Carefree Highway, with the FRP so that proper emergency response occurs in the area.

The no action alternative would mean that flooding around these structures is probable. Possible "washouts" could occur and access to many residents and businesses would be lost if this occurred. The Carefree Highway serves as a critical access to the New River and Desert Hills areas. Emergency response and general access would become limited in the event that "washouts" occur.

Environmental – LSD provided an environmental summary for Site Number 6. Drainage structures added in residential areas could be made wildlife-friendly and could help restore smaller wash connectivity. This site is located in survey zone 3 for CFPO. A few storage tanks at convenience stores and farms are present within the area. Drainage structures constructed in this area would need to be visually compatible with nearby residences. The Carefree Highway corridor is designated as a scenic corridor. The visual character in this area is mostly "rural ranch residential" with numerous equine facilities. Little consistency exists in the area with regard to material, style, or color. Any drainage structures constructed would need to be visually compatible with nearby residences.

Site Number 7

Problem Description – The Cave Creek Watercourse Master Plan identified this site as a problem area. Site 7 became a problem when the decision was made to locate 24th Street north of the Carefree Highway in the bottom of Apache Wash. The roadway and Apache Wash coexist for nearly 700 feet at one location and about 250 feet at another.

In the 100-year event of 7,210 cfs 24th Street is impassable. 24th Street is a primary artery for the area north. This situation will only increase in severity as the area north continues to develop.

Alternatives –Design flows for this site came from Part 3, Volume 1 of the ADMP report. The design 100-year peak flow of 7,210 cfs comes from the north and flows directly south encompassing 24th Street for most of its length from Cloud Road to the Carefree Highway.

The full structural alternative consists of realigning 24th Street so that is moves to the west of its current location up out of Apache Wash. Although this alternative is somewhat challenging, it is still considered a very viable alternative. The roadway would be relocated generally along the natural ridge to the west of its current alignment. At the Carefree Highway, the intersection would also need to be shifted west of Apache Wash so that there is no need for crossing of the wash at all. At Cloud Road, the current intersection could be left alone since the roadway can be swung back into its original location at this point. The Road can be built in the floodplain fringe and elevated to preserve land. In fact, a breakout area just north of the Carefree Highway could be eliminated and kept within the Apache Wash corridor. No new culvert would be required to cross Apache Wash. A relief culvert may be required at the Carefree Highway depending on how the breakout flow is actually handled. This realignment alternative removes the roadway out of the flood hazard and becomes an all weather access. No Apache Wash crossings are needed. The opportunity of stopping breakout flow from Apache Wash, if that is considered desirable, could also be accomplished with this alternative. All of the adjacent land is ASLD trust land. Because of this, the possibility exists for cost share either with the State Land Department or with a potential buyer of this property.

The non-structural alternative consists of the FRP. In heavy flood events, 24th Street would be barricaded and emergency access to the north would have to enter along Cloud Road.

The Combination alternative would combine the full structural alternative with the FRP. By combining the two alternatives, the roadway would become an all weather access and emergency response and access would be maintained.

The no action alternative would have the effect of leaving the roadway in the state that it currently exists. In heavy flood events, the roadway will become impassable, access will be severely hampered, emergency response will become less effective, and the roadway will require heavy maintenance to bring it back into service. The probability of "wash outs" is very high.

Environmental – LSD provided an environmental summary for Site Number 7. It is important that the connectivity to the Carefree Highway be done in such a manner that improvements are made to the multiuse path along the corridor. Drainage structures added in residential areas could be made wildlife-friendly and could help restore smaller wash connectivity. The avoidance of stock tanks and paloverde-mixed cacti association at this site is also important. This site is located in survey zone 3 for CFPO. Habitat restoration is a real possibility for Apache Wash. The Carefree Highway corridor is designated as a scenic corridor. The visual character in this area is mostly "rural ranch residential" with numerous equine facilities. Little consistency exists in the area with regard to material, style, or color. Any drainage structures constructed would need to be visually compatible with nearby residences.

Site Number 8

Problem Description – Included in the sites recommended for upgrade in the Skunk Creek Watercourse Master Plan was Site Number 8. Site Number 8 is the confluence of Desert Hills Drive and Skunk Creek (Figure 5.8).

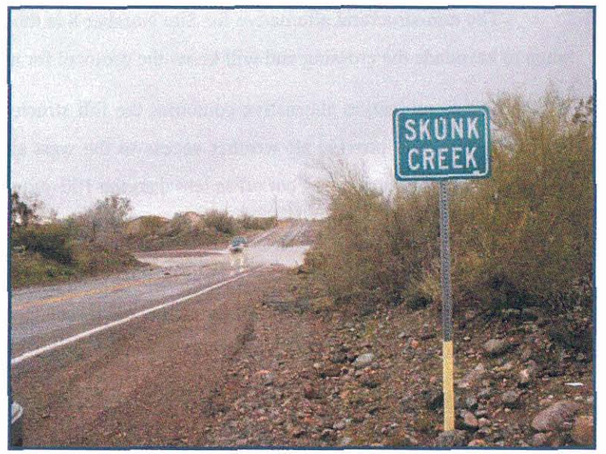


Figure 5.8 Skunk Creek Crossing at Desert Hills Drive (1-1-02)

At this location, the flow coming down Skunk Creek intersects Desert Hills Drive, which is a low water crossing. All flow, including minor nuisance flow, crosses over the roadway surface creating a frequently closed situation. This crossing

is continually barricaded during storm events.

From the discussion in for Site Number 3, this location is one of two access points to the area west of Skunk Creek. Currently, if the roadway at Cloud Road and 27th Avenue were washed out and Site Number 8 was inundated with active flow, access to the west side of Skunk Creek would be cut off and residents would be stranded. Additionally, this would not allow for emergency services to cross Skunk Creek. The new Daisy Mountain fire station is located just east of Skunk Creek on Desert Hills Drive and 11th Avenue.

Alternatives – Only one full structural alternative makes sense at this site and that is to bridge the crossing. The flows in this location are too large to warrant box culverts and would not allow for wildlife to cross under the roadway. The actual bridge looked at for this alternative is one that would span the floodplain. This is necessary so that the current flows are not disturbed in any way. Increasing water surface elevations at this location would mean increased flooding to current structures.

One additional problem had to be solved for Site Number 8 because of the placement of the bridge itself. In order for the bridge to be able to span the floodplain, it cuts off access from Desert Hills Drive onto 15th Avenue, which is located just east of Skunk Creek in the floodway. For the full structural alternative, 15th Avenue access would be accomplished by upgrading Tanya Road to a paved section from its intersection with 15th Avenue east to 11th Avenue. 11th Avenue would also be upgraded to a paved section from Tanya Road north to the intersection of Desert Hills Drive.

The non-structural alternative for Site Number 8 is the FRP. With the FRP, emergency responders will know when to barricade the crossing and will know the protocol for access.

The Combination alternative combines the full structural bridge construction and access improvements with the FRP. This will provide all weather access to the west side of Skunk Creek and allow for emergency services access so that residents are not cut off in less than the 100-year event.

The no action alternative would allow for flooding to continue occurring across the low water crossing. Desert Hills Drive would continue to be shut down in high frequency events and emergency response into the area west of Skunk Creek would continue to be hampered. Desert Hills Drive would continue requiring heavy maintenance after such events (Figure 5.9).

Environmental – LSD provided an environmental summary for Site Number 8. Drainage structures added in residential areas could be made wildlife-friendly and could help restore smaller wash connectivity. This site is located in survey zone 3 for CFPO. Drainage structures constructed in this area would need to be visually compatible with nearby residences. The visual character in this area is mostly "rural ranch residential" with numerous equine facilities. Little consistency exists in the area with regard to material, style, or color.

Figure 5.9 Skunk Creek Crossing Maintenance at Desert Hills Drive (9-19-04)

Site Number 9

Problem Description – While looking at the issue of access throughout the Desert Hills/New River area for the Flood Response Plan, the Skunk Creek WCMP identified this location as a problem area for access north into New River. The ADMP team analyzed the issues associated with the area and agreed that the culvert crossing at Rodger Creek and the New River Road was in imminent danger of failure. If this were to occur, the only access into the New River area is from the I-17 exit to the west. Emergency services would be greatly hampered because of the distance that would have to be taken to get north into the area.

Flow in Rodger Creek coming from the northeast out of the area between Pyramid Peak and Apache Peak to the north crosses the New River Road in two 8 foot diameter culverts. The headwalls of these culverts are hand placed rock and are very old and damaged. The 100-year peak discharge overtops the roadway making it impassable. Once flow exits these structures, serious erosion problems along the southern bank is evident (Figure 5.10) and needs to be replaced or

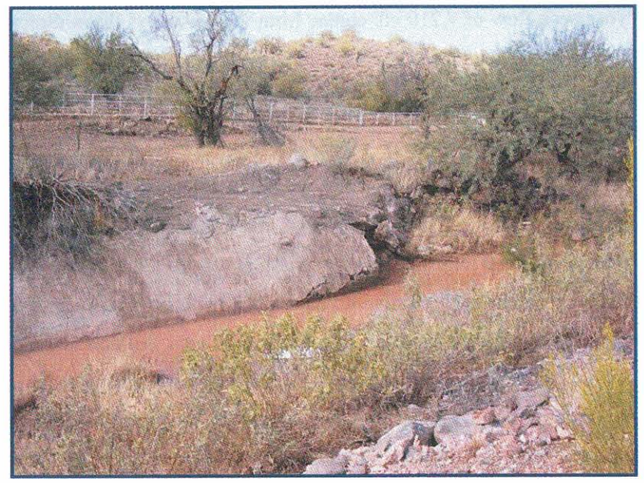


Figure 5.10 Rodger Creek Crossing Erosion Damage at New River Road (9-19-04)

modified so that it functions more efficiently. The flow in Rodger Creek also inundates a floodway residence downstream of the crossing before it eventually enters Skunk Creek.

Alternatives – The full structural alternative for Site Number 9, like Site Number 8, is a 400 foot long span bridge over Rodger Creek that would span the floodplain. The roadway profile would need to be raised to accommodate the flow from Rodger Creek, but containment of the flow would be the driving force for the expense needed to achieve a bridge. A bridge would provide a 100-year all weather access, reduce the floodplain elevation and limits upstream of the culverts, and would potentially reduce scour of the left bank downstream due to existing culvert outflows. The cost is high, but MCDOT is a potential partner. A bridge would also improve moderate habitat in the area to high and would provide a corridor for the Maricopa County trail system. This alternative does not remove the residence located within the floodway from the current hazard.

The non-structural alternative for this site is the FRP. The FRP will provide the protocol needed for emergency services in and around this crossing. The FPAP program would also be recommended for the one residence located within the floodway of Rodger Creek.

The combination alternative combines both the full structural alternative and the FRP. This will allow for all weather access to the area north in events less than the 100-year event for emergency services as well as the general public. Once again, the FPAP program would still be recommended for the residence located within the floodway of Rodger Creek.

The no action alternative would have the effect of allowing flooding of less than the 2-year event to continue to occur at the crossing. Erosion of the downstream left bank will continue and access north for all access will be greatly damaged. Emergency services will be limited to access off of the I-17 if the probable "wash out" occurs.

Environmental – LSD provided an environmental summary for Site Number 9. Lots of undisturbed Arizona Upland vegetation (upland tree and cacti) exist within the area of the site. This site is located in survey zone 3 for CFPO as will as the Sonoran Desert Tortoise (SDT). Scattered illegal dumping is present throughout the area. The Lake Pleasant to Cave Creek regional trail alignment is proposed along the right-of-way of this site. Drainage structures constructed in this area would need to be visually compatible with nearby residences. Many prominent views to the surrounding landforms are present around the site. The visual character in this area is mostly "rural ranch residential" with numerous equine facilities. This area is even more rustic with rolling terrain and undisturbed uplands. Little consistency exists in the area with regard to material, style, or color.

Site Number 10

Problem Description – Site Number 10 evolved from discussions and field visits of the ADMP team. It was observed that flow in the Cline Creek tributary to Skunk Creek coming southwest out of the Tonto National Forest made a large sweeping bend (Figure 5.11)at the base of Circle Mountain Road before it continued under the New River Road Bridge. Circle Mountain Road is elevated approximately 10 feet above the bottom of the wash bottom. The sideslope embankment of the roadway is currently unprotected from erosion in any way.

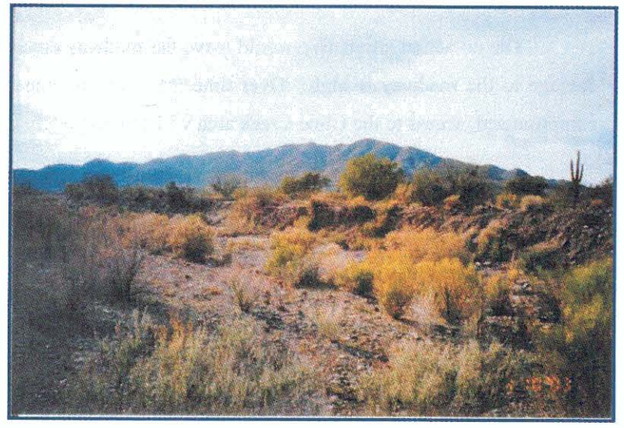


Figure 5.11 Cline Creek at Circle Mountain Road (1-10-03)

The reason that this particular location is critical is due to the fact that this is the sole access into the Cline Creek Area. If the roadway embankment were to fail due to erosion, access would be cut off for approximately four square miles of developed land. Emergency access would only be available through the air.

Alternatives – Site Number 10 is highly visible to the surrounding area, so aesthetics is an important factor in the solution chosen for this site. The full structural alternative for this site consists of terraced walls that would be supplemented with a more naturalized treatment such as native plants and grasses. This alternative is much more visually pleasing as opposed to the more hard engineered solutions looked at in the Phase I. This treatment would actually incorporate terraced gabion baskets that would be placed into the embankment. Dumped rock riprap would be placed below the gabions to protect the toe of the slope to the scour depth. Backfill would then be placed over the gabion baskets and riprap. The embankment would then be planted with natural vegetation of a type that would hold the slope in higher recurrence interval storms such as the 2-year event. Maintenance of the site would be necessary if a larger (100-year) event occurred that removed the top layer of the treatment. The integrity of the roadway embankment would not be compromised in anything less than a 100-year event.

The non-structural alternative for this site is new floodplain delineation and the FRP. The new floodplain delineation would better define the flood hazard within the area and the FRP would set protocol in the event of heavy rain and flooding.

The combination alternative would be a combination of the full structural alternative supplemented with the FRP. This alternative would protect the roadway from damage and set protocol for emergency services.

The no action alternative would leave the roadway embankment as well as the wash alone. The potential for damage to the roadway is high. Over time the roadway embankment will erode. If the roadway embankment is compromised, access to the Cline Creek area will be completely cut off.

Environmental – LSD provided an environmental summary for Site Number 10. Lots of undisturbed Arizona Upland vegetation (upland tree and cacti) exist within the area of the site. This site is located in survey zone 3 for CFPO as well as the SDT. Scattered illegal dumping is present throughout the area. Links need to be maintained to open space in the Pyramid Peak area. Drainage structures constructed in this area would need to be visually compatible with nearby residences. Many prominent views to the surrounding landforms are present around the site. The visual character in this area is mostly "rural ranch residential" with numerous equine facilities. This area is even more rustic with rolling terrain and undisturbed uplands. Little consistency exists in the area with regard to material, style, or color.

Site Number 11

Problem Description – During the course of the WCMP, the WCMP team identified Site Number 11 as a considerable problem area. Problems associated with the area are; residences in the floodway, flow breakouts occurring in many locations, and a bridge that has a very severe skew with regards to the flow of Skunk Creek.

Flows come down from the north in Skunk Creek. When they get to Wolf Trap Road, they begin to break out to the west and southwest. The flow continues to breakout from this location until approximately 600 feet north of the New River Road Bridge. The flow that breaks out continues west/southwest until it reaches the New River Road. At this point the flow inundates the roadway, crosses to the south, floods several residences, then turns southeast until it intersects back into Skunk Creek.

This occurs because of the following reasons; the channels in the area are braided with low banks that tend to allow flow to jump between flowpaths from flow event to flow event and flows, as they approach the bridge, are backed up due to the skew of the bridge combined with steeper slopes approaching the bridge flattening out causing the stream to drop its sediment and agrade through the bridge section increasing the water surface elevations and therefore pushing water out of the system.

Breakout that reaches New River Road just west of the bridge occurs in less than the 10-year recurrence interval and occurs at a rate of between 700 and 1000 cfs. The velocities impacting the road at this location are on the magnitude of 5 to 8 feet per second. Approximately 20 homes are impacted by this breakout in one form or another.

Alternatives – Modeling of this area has taken on many forms. The FCDMC commenced FLO-2D modeling of this area prior to the beginning of this project which continues to the current date. The current FIS study, performed by Montgomery Watson in 1997, is the current regulated floodplain/floodway for Skunk Creek. Part 4, Volumes 1 and 2 of the ADMP are a mix of detailed and approximate zone A delineations of Skunk Creek to just below the confluence of tributary 6B and Skunk Creek to the County boundaries in the north. This study also included a portion of tributary 6B and tributary 28.8339. Part 4, Volumes 7 and 8 of the ADMP, are floodplain delineations that include portions of Cline Creek Tributary C6, Skunk Creek Tributary 10A, Upper Skunk Tank Wash, East Fork Desert Lake Wash and West Fork Apache Wash. Of these the Skunk Creek Tributary 10A enters Skunk Creek just south of Wolf Trap Road. All of these studies provided backup to the analysis of Site Number 11.

The full structural alternative for Site Number 11 is to construct levees upstream and downstream of the New River Road Bridge (Figure 5.12). These levees would stretch approximately 6,200 lineal feet and would be constructed along both banks confining the flows within Skunk Creek upstream and downstream of the bridge. This alternative would remove all of the homes from the Skunk Creek floodway, keep New River Road an all weather access during 100-year recurrence intervals, and protect all of the homes in the breakout area. The downside to this alternative is that it will carry a high price tag, flows that naturally flow into Skunk Creek currently would be difficult to bring into the system, and the levees could create a negative visual impact to the surrounding area. This alternative has some challenges associated with it. The acquisition of right-of-way for the levee system may be difficult, the permitting required for construction could be expensive and difficult, visual design of the levees will be expensive and challenging, and the habitat value around the bridge is moderate to high and would be impacted. JEF also performed an analysis using the FlowMaster computer program to determine the range of channel bottom widths that would be acceptable based on depth and velocity. The results of this analysis are that at 24 foot bottom width and 3 to 1 sideslopes the channel velocity is 16.74 feet per second. At a channel bottom width of 40 feet, the resulting velocity is 16.21 feet per second. Even though the depths reduce, the velocity remains somewhat constant creating the need for grade control structures, energy dissipaters, and possible erosion protection to reduce erosion within the final design.

The non-structural alternative for Site Number 11 is new floodplain delineations (FDS), the FPAP, and the FRP. The new FDS will provide the actual limits of the flood hazard for the new channelized reach. The FRP will provide protocol for emergency responders.

The combination alternative combines the full structural alternative with the non-structural alternative minus the FPAP. This alternative would remove all of the homes from the floodway and keep New River Road an all weather access during 100-year recurrence intervals. The full structural alternative followed by a new FDS would

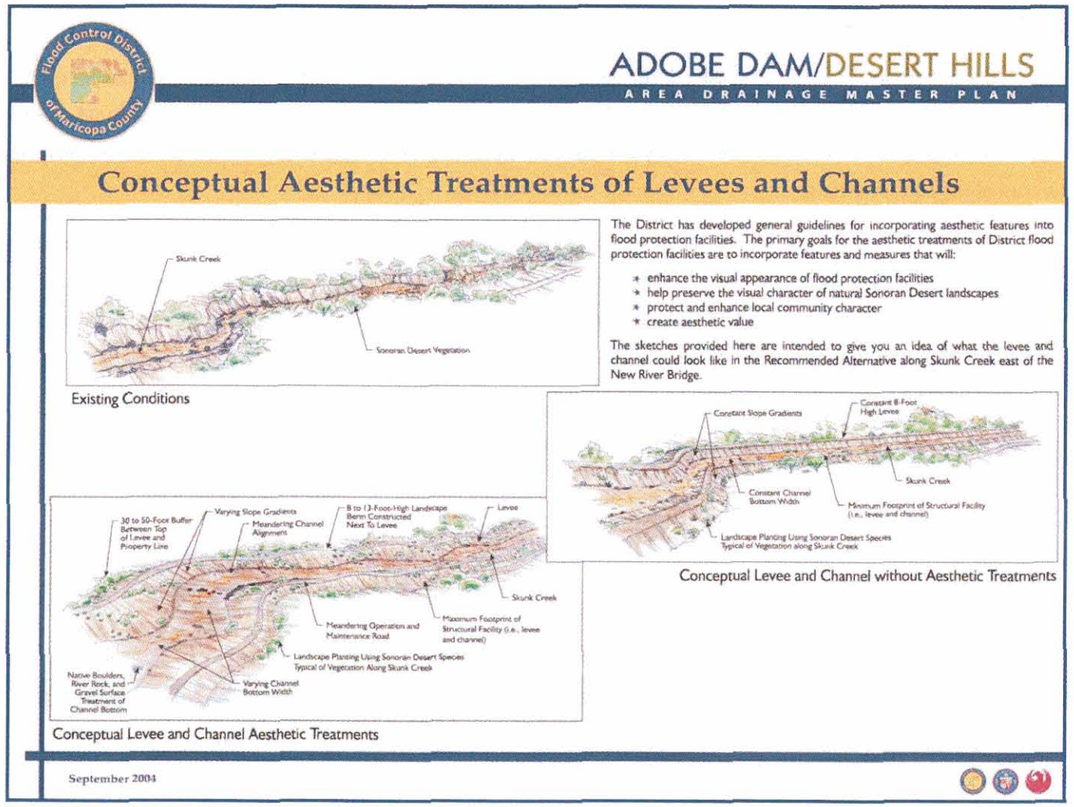


Figure 5.12 Site Number 11 Levee Concepts (9-04)

provide an accurate record of the actual flood hazard. The FRP would still provide protocol for emergency responders in the site area.

The no action alternative would have the effect of allowing the current flooding to continue to happen. The FPAP program would need to be recommended for approximately 20 residences and access in less than a 100-year event is likely to occur. Maintenance issues at the bridge will continue to be a reoccurring problem and emergency services into the area will be severely hampered.

Environmental – LSD provided an environmental summary for Site Number 11. Lots of undisturbed Arizona Upland vegetation (upland tree and cacti) exist within the area of the site. This site is located in survey zone 3 for CFPO as well as the SDT. Long reaches of intact xeroriparian vegetation would be disturbed at this site. Scattered illegal dumping is present throughout the area. Proposed trails running parallel to this site are recommended. Drainage structures constructed in this area would need to be visually compatible with nearby residences. Many prominent views to the surrounding landforms are present around the site. The visual character in this area is mostly "rural ranch residential" with numerous equine facilities. This area is even more rustic with rolling terrain and undisturbed uplands. Little consistency exists in the area with regard to material, style, or color.

Site Number 12

Problem Description – Site Number 12 was identified by the ADMP team during their review of the Desert Hills area. At this location Desert Hills Wash flows from the north until it intersects Cloud Road. Flow then exceeds the limits of the banks and begins to inundate residences below Cloud Road.

Reduction of the peak discharge somewhere in the vicinity of Cloud Road and 12th Street would be necessary to remove the downstream residents from the floodway.

Alternatives – Design flows for this site came from Part 3, Volume 1 of the ADMP report. The design 100-year peak flow of 3,296 cfs was taken from the ADMP report. The volume associated with the 100-year design flow is 339 acre feet.

In order to protect the downstream floodway residents, this design flow would need to be reduced to 1,200 cfs which is somewhat closer to the 10-year peak discharge. The volume required for detention would need to be closer to 120 acre feet.

Three structural alternatives were analyzed for the full structural alternative. Each of the alternatives includes a detention basin that would scalp the peak down, attempting to reduce it to a level acceptable for outlet design. The only difference between the three alternatives is the location and size of the detention basin. However, when CLW attempted to take the three alternatives and put an actual design onto them, it was discovered that all three alternatives were not feasible based on one of two reasons. Either the basin could not be made large enough so that enough volume was captured based on the land available, or too many residences would need to be acquired in order to obtain enough land for the basin construction. Because of these reasons, this site was not analyzed further. No full structural alternative was found to be feasible.

The non-structural alternative consists of the FRP, development guidelines and the FPAP. Residences located within the floodway will be recommended to the FPAP program. This will remove them from the floodway and allow for the FCDMC to reclaim those portions of the floodway for purposes suitable for floodway use. The FRP would set protocol for emergency responders. The new development guidelines would shape the way that future development was allowed to occur so that impacts of development is limited to the bounds that are set by the County.

The combination alternative is the same as the non-structural alternative.

The no action alternative would have the effect of not providing timely flood response by emergency services. The residences located in the floodway would continue to be flooded in high frequency events. Finally, future development upstream of Site Number 12 will continue to happen haphazardly as it currently does increasing the probability of flooding.

Environmental – LSD provided an environmental summary for Site Number 12. Drainage structures added in residential areas could be made wildlife-friendly and could help restore smaller wash connectivity. This site is located in survey zone 3 for CFPO. Drainage structures constructed in this area would need to be visually compatible with nearby residences. The visual character in this area is mostly "rural ranch residential" with numerous equine facilities. Little consistency exists in the area with regard to material, style, or color.

5.2 Plan and Profile Sheets and Cost Estimates

Plan and Profiles – The plan and profile sheets were put together with updated aerial photography and topography. Existing utilities are shown in the plan view, but actual depths of these utilities are unknown. The profiles show the existing ground compared to the proposed structural alternative. Each sheet details the design flows, plan view of the full structural alternative, profile of the full structural alternative, and typical cross sections either on the sheet or accompanying the main sheet. Refer to Appendix A for all plan and profile sheets and typical sections. Refer to Part 8, Volume 4, *Alternatives Formulation Report Appendices* for more detailed information regarding structural alternatives.

Cost Estimates – Cost estimates were performed by JEF. Many of the cost estimates provide a range of costs based on the land needed to construct the alternative. The lower range cost was based on the amount of land needed if only the footprint of the alternative was purchased. This is obviously going to be a cost that is too low based on the fact that it would be very difficult if not impossible to purchase just the land needed for right-of-way. Because of this, an upper range was established based on the purchase of every parcel that the alternative comes in contact. The actual cost is going to fall somewhere between these two. At the time of the analysis (July, 2004), the land costs are assumed to equal $1.50 per square foot of raw ground or $65,340.26 per acre as provided by the FCDMC. Refer to Appendix B for all cost estimates.

5.3 Recommended Alternative

On November 18th, 19th, and 20th, 2003 the ADMP team presented the four preliminary alternatives to the public. These meetings were intended to present the alternatives, gain public input and comments, and build public support of the project as well as the preliminary alternatives. Refer to Part 1, Volume 1, Section 3 for a more detailed account of the public meetings.

On July 29th, 2004 the ADMP team sat down with the information that had been gathered from the data collection, public meetings, alternative analysis, and team input and formulated the recommended alternative. The following is a description of the criteria that was used for the qualitative evaluation, the information recorded during the discussions, and a summary of the recommended alternative.

Criteria – The ADMP team formulated criteria that were used to evaluate the preliminary alternatives. Refer to Table 5.6 for the criteria and guidelines for using the criteria.

Table 5.6

Recommended Alternative Evaluation Criteria

Criteria (Followed by Guidelines)	
1) Public Safety Enhancement • Reduce Flood Level • Number of People Impacted • Improve Public Infrastructure	2) Level of Damage Reduction • Dollar Costs Saved/Reduced • Flood Frequency Impacted
3) Access Critical Location • Collector or Arterial Roadway • Only Access • Number of People Impacted	4) Upstream/Downstream Impacts • Stand Alone • Systematic Solution
5) Comparative Size of Watercourse • Greater than 50 CFS • Greater than 500 CFS • Greater than 5,000 CFS	6) Eliminates Flood Problem • Partial Solution • Whole Solution
7) Eliminates Erosion Problem • Partial Solution • Whole Solution	8) Cost of Implementation • < than $50,000 • < than $500,000 • < than $1,000,000

Table 5.6

Recommended Alternative Evaluation Criteria

Criteria (Followed by Guidelines)	
9) ROW Acquisition Necessary • Existing ROW Available • Amount Needed • Private or Public Land	10) Condemnation Required • Private or Public
11) Maintenance Cost • Lessened • Increased • Neutral • Comparative to Other Measure	12) Potential Cost Sharing Partner • Already Contacted • Already Willing • Possibly
13) Comparative Benefit Cost • Dollars • Number of People • Regional Solution	14) Addresses Public Complaint/Concern • Response From Public
15) Public Support • Known • Anticipated • Unknown	16) Agency Acceptance • Known • Anticipated • Applicable • Unknown
17) Environmental Impacts • Decrease Habitat • Increase Habitat • Hazmat • Cultural • 404	18) Multi-Use Opportunities • Known Compatibility • Possible Compatibility
19) F.C. Method Compatible with Setting • Land Use Plan • Visual Impacts • Material/Form	

Evaluation – As was stated before, the evaluation by the ADMP team was a qualitative evaluation. As the team looked at each of the sites, they evaluated it based on the criteria and guidelines presented in Table 5.6. This information was recorded and placed into an evaluation matrix. Refer to Appendix C for completed evaluation matrices.

Summary of Recommended Alternative – From the ADMP team evaluation, public input, stakeholder input, and detailed analysis for each of the site, a recommended alternative emerged. A summary of the Phase II Recommended Alternative can be found in Table 5.7.

Based on the results of the alternatives evaluation and the collective input of the stakeholders and the public, the project team recommended, with the District's concurrence, that the Recommended Alternative be advanced for further refinement. The District authorized the project team to proceed with the Recommended Alternative of the Adobe Dam/ Desert Hills ADMP on July 29th, 2004. The Recommended Alternative is documented in Part 9, Volumes 1 & 2.

Table 5.7 Adobe Dam/ Desert Hills Area Drainage Master Plan Recommended Alternative

Problem Site Identification	Phase II Site Number	Recommended Alternative
City of Phoenix		
Skunk Creek/ Pinnacle Peak Rd & 35th Ave	Site Number 1	Channelization/ grade control and the Flood Response Plan (FRP)
Skunk Creek downstream of the CAP	Site Number 2	Levees followed by Floodplain Re-Delineation (FDS) and the Flood Response Plan (FRP)
Desert Hills		
Cloud and 27th Avenue	Site Number 3	Flood Response Plan (FRP) and No Action
Skunk Tank Wash (Joy Ranch Road to 19th Avenue	Site Number 4	Floodprone Property Acquisition Program (FPAP), Flood Response Plan (FRP), Development Guidelines, and Joy Ranch Road Interceptor upstream detention basin (Part of Site 5)
Desert Lake (ASLD parcel), Desert Lake Wash downstream of Cloud Rd, and East fork Desert Lake Wash/ 7th St	Site Number 5	Basin on ASLD parcel/ channelization, 100-yr Channel/ Culverts @ 7th St followed by Floodplain Re-Delineation (FDS), Flood Response Plan (FRP), Floodprone Property Acquisition Program (FPAP) south of Cloud Road, and Development Guidelines
Carefree Highway Crossings	Site Number 6	Flood Response Plan (FRP) and No Action
Apache Wash/ 24th St	Site Number 7	Flood Response Plan (FRP) and Realignment of the roadway
Skunk Creek/ Desert Hills Drive	Site Number 8	Flood Response Plan (FRP) and constructed bridge with bypass access on side streets
Desert Hills Wash/ Cloud Rd & 12th St	Site Number 12	Flood Response Plan (FRP), Floodprone Property Acquisition Program (FPAP), and Development Guidelines
New River		
Roger Creek/ New River Rd	Site Number 9	Flood Response Plan (FRP), Floodprone Property Acquisition Program (FPAP), and constructed bridge
Cline Creek/ Circle Mountain Rd	Site Number 10	Flood Response Plan (FRP), Constructed terraced wall w/ naturalized treatment, and Floodplain Delineation Study (FDS)
Skunk Creek/ New River Rd Bridge	Site Number 11	Levees/ Channel improvements followed by Floodplain Re-Delineation (FDS) and Flood Response Plan (FRP)

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Tetra Tech, Inc., *Floodplain Delineation Study for Skunk Creek Between the Central Arizona Project and Happy Valley Road, Two-Dimensional Hydraulic Model,* June, 2002.

University of Florida, McTrans Center for Microcomputers in Transportation, *HY-8 Computer Program,* Version 4.0.

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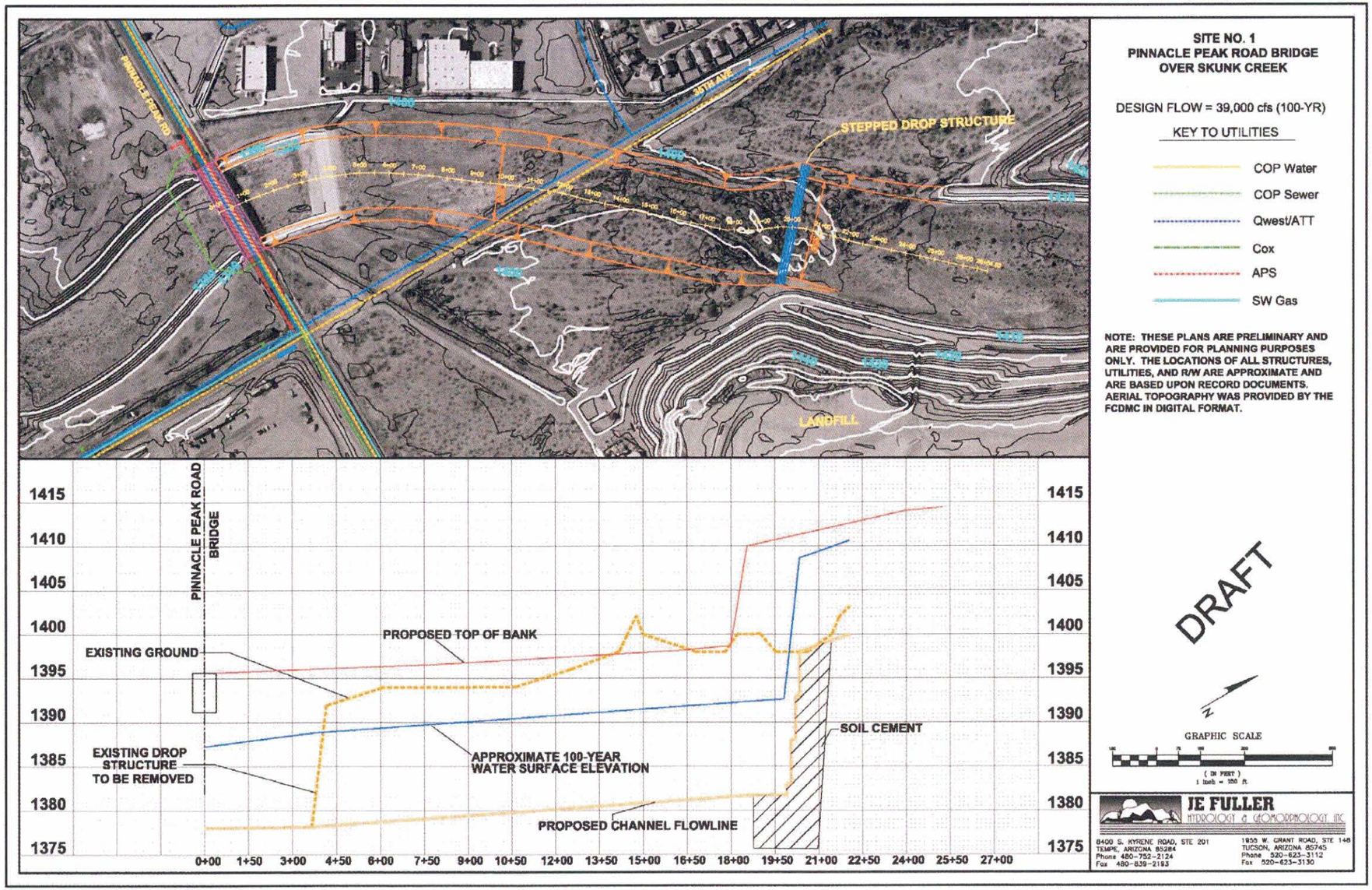
APPENDIX A

Plan and Profile Sheets with Typical Cross Sections


PINNACLE PEAK RD
35TH AVE
STEPPED DROP STRUCTURE
LANDFILL
1415
1410
1405
1400
1395
1390
1385
1380
1375
PINNACLE PEAK ROAD BRIDGE
EXISTING GROUND
PROPOSED TOP OF BANK
EXISTING DROP STRUCTURE TO BE REMOVED
APPROXIMATE 100-YEAR WATER SURFACE ELEVATION
SOIL CEMENT
PROPOSED CHANNEL FLOWLINE
0+00 1+50 3+00 4+50 6+00 7+50 9+00 10+50 12+00 13+50 15+00 16+50 18+00 19+50 21+00 22+50 24+00 25+50 27+00
SITE NO. 1
PINNACLE PEAK ROAD BRIDGE
OVER SKUNK CREEK
DESIGN FLOW = 39,000 cfs (100-YR)
KEY TO UTILITIES
COP Water
COP Sewer
Qwest/ATT
Cox
APS
SW Gas
NOTE: THESE PLANS ARE PRELIMINARY AND ARE PROVIDED FOR PLANNING PURPOSES ONLY. THE LOCATIONS OF ALL STRUCTURES, UTILITIES, AND R/W ARE APPROXIMATE AND ARE BASED UPON RECORD DOCUMENTS. AERIAL TOPOGRAPHY WAS PROVIDED BY THE FCDMC IN DIGITAL FORMAT.
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N
GRAPHIC SCALE
(IN FEET)
1 inch = 150 ft.
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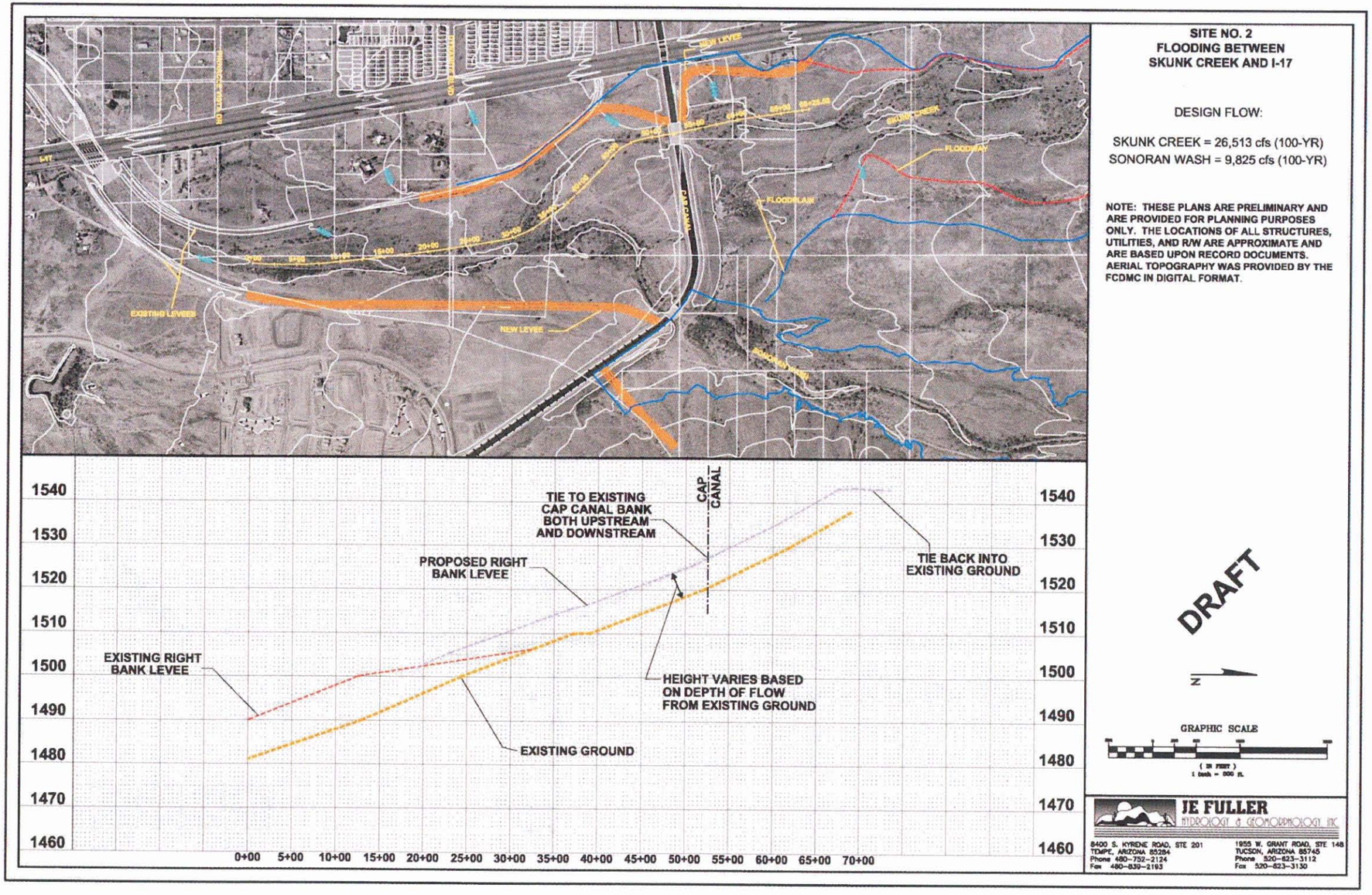
HYDROLOGY & GEOMORPHOLOGY, INC.
8400 S. KYRENE ROAD, STE 201
TEMPE, ARIZONA 85284
Phone 480-752-2124
Fax 480-839-2193
1955 W. GRANT ROAD, STE 148
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130


SITE NO. 2
FLOODING BETWEEN
SKUNK CREEK AND I-17
DESIGN FLOW:
SKUNK CREEK = 26,513 cfs (100-YR)
SONORAN WASH = 9,825 cfs (100-YR)
NOTE: THESE PLANS ARE PRELIMINARY AND ARE PROVIDED FOR PLANNING PURPOSES ONLY. THE LOCATIONS OF ALL STRUCTURES, UTILITIES, AND R/W ARE APPROXIMATE AND ARE BASED UPON RECORD DOCUMENTS. AERIAL TOPOGRAPHY WAS PROVIDED BY THE FCDMC IN DIGITAL FORMAT.
EXISTING LEVEES
NEW LEVEE
SKUNK CREEK
FLOODPLAIN
CAP CANAL
TIE TO EXISTING CAP CANAL BANK BOTH UPSTREAM AND DOWNSTREAM
PROPOSED RIGHT BANK LEVEE
TIE BACK INTO EXISTING GROUND
EXISTING RIGHT BANK LEVEE
HEIGHT VARIES BASED ON DEPTH OF FLOW FROM EXISTING GROUND
EXISTING GROUND
1540
1530
1520
1510
1500
1490
1480
1470
1460
0+00 5+00 10+00 15+00 20+00 25+00 30+00 35+00 40+00 45+00 50+00 55+00 60+00 65+00 70+00
DRAFT
N
GRAPHIC SCALE
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HYDROLOGY & GEOMORPHOLOGY, INC.
8400 S. KYRENE ROAD, STE 201
TEMPE, ARIZONA 85284
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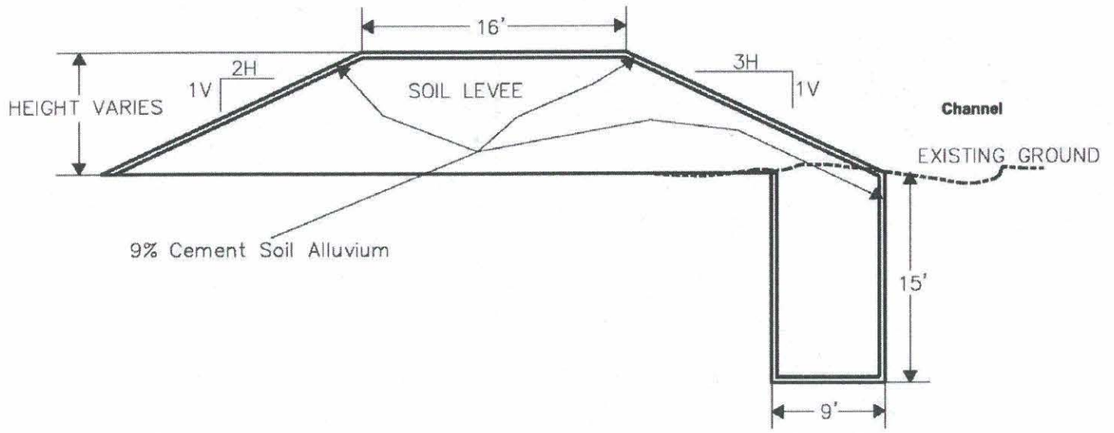
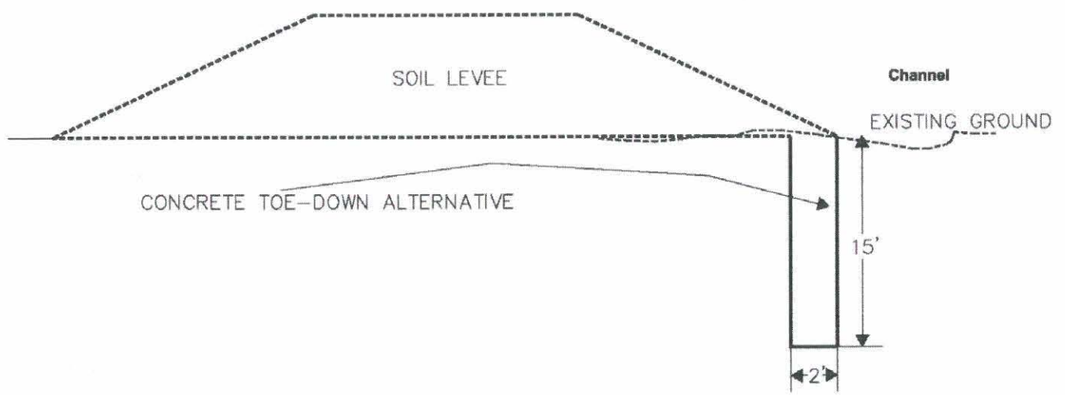
Fax 480-839-2193
1955 W. GRANT ROAD, STE 148
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130





SITE NO. 2
FLOODING BETWEEN
SKUNK CREEK AND I-17

TYPICAL LEVEE CROSS-SECTION

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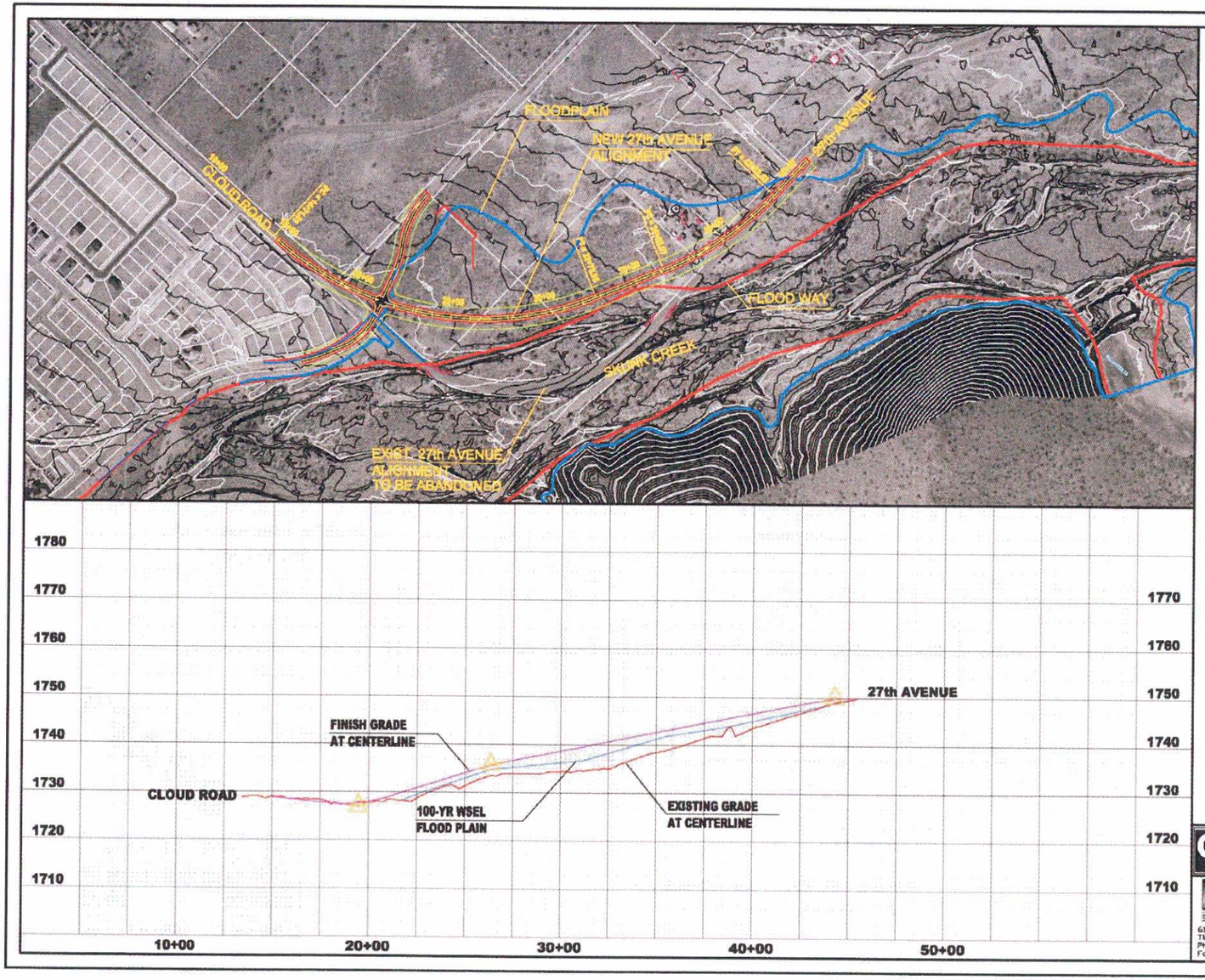
Fax 480-839-2193
1955 W. GRANT ROAD, STE 148
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130



SITE NO. 3
27TH AVENUE
AT CLOUD ROAD

DESIGN FLOW = 27,700 cfs (100-YR)

KEY TO UTILITIES

Qwest/ATT

APS

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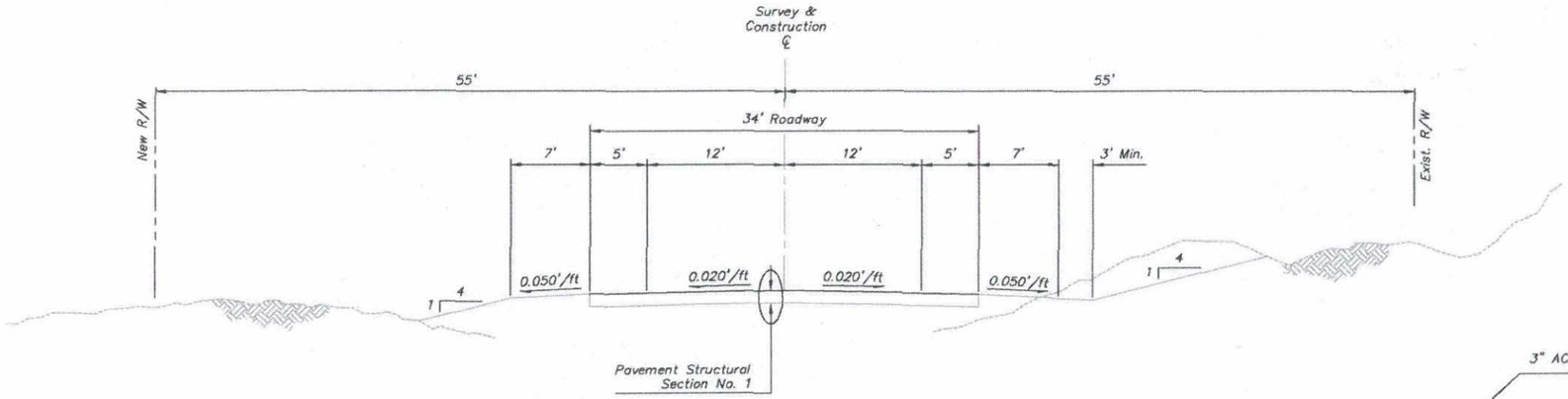
GRAPHIC SCALE

(IN FEET)
1 inch = 250 ft.

C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4720 West Maverick Lane #103
Lakeside, Arizona 85929
Phone 928.368.2248 Fax 928.368.8704

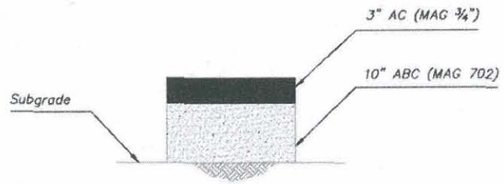
JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193

2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-2112
Fax 520-623-3130



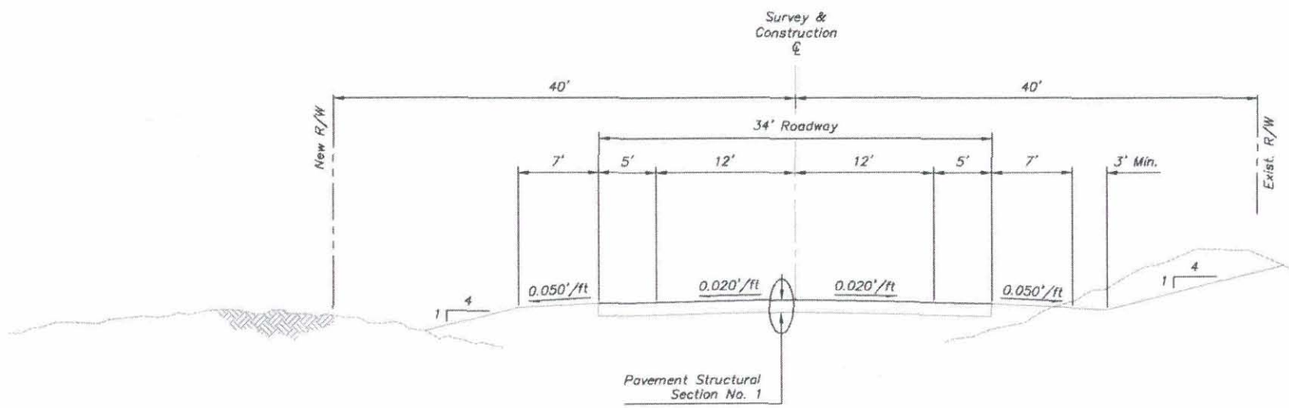
TYPICAL SECTION FOR CLOUD ROAD TO 27TH AVE

Rural Collector Road (at Section Line)



Total Thickness = 13"

SECTION NO. 1



TYPICAL SECTION – ALL OTHERS

Rural Collector Road (Minor)

NOTE: PER MCDOT 93 ROADWAY DESIGN MANUAL

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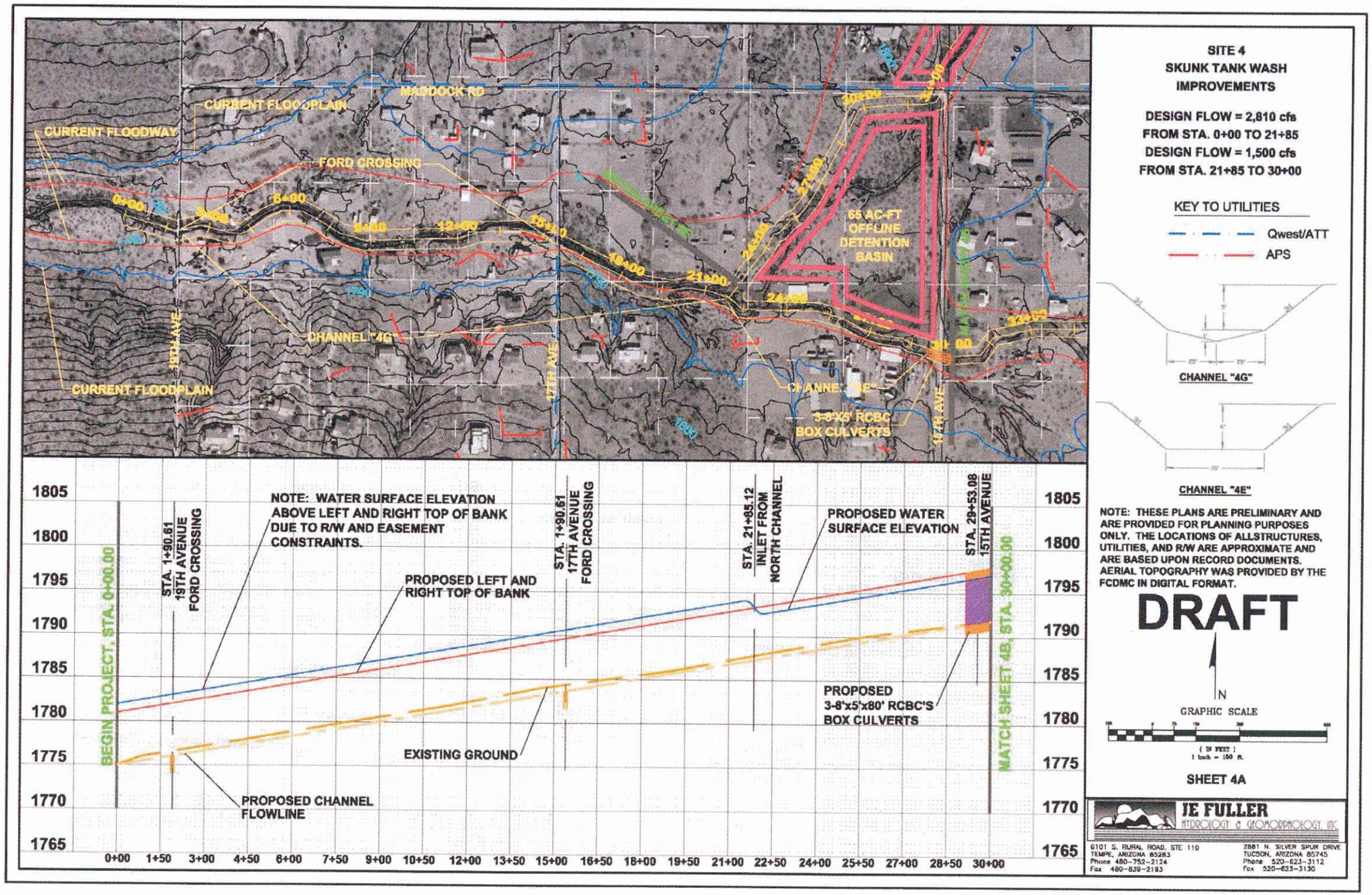
HYDROLOGY & GEOMORPHOLOGY, INC.
8101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-730-3124
Fax 480-829-2193
3881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3113
Fax 520-623-3139
C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4720 West Maverick Lane #103
Lakeside, Arizona 85929
Phone 928.368.2248 Fax 928.368.8704


CURRENT FLOODPLAIN
CURRENT FLOODWAY
MADDOCK RD
FORD CROSSING
0+00
3+00
6+00
9+00
12+00
15+00
18+00
21+00
24+00
27+00
30+00
19TH AVE
CHANNEL "4G"
CURRENT FLOODPLAIN
17TH AVE
65 AC-FT OFFLINE DETENTION BASIN
CHANNEL "4E"
3-8'X5' RCBC BOX CULVERTS
17TH AVE
1680
1805
1800
1795
1790
1785
1780
1775
1770
1765
BEGIN PROJECT, STA. 0+00.00
STA. 1+90.61 19TH AVENUE FORD CROSSING
NOTE: WATER SURFACE ELEVATION ABOVE LEFT AND RIGHT TOP OF BANK DUE TO R/W AND EASEMENT CONSTRAINTS.
PROPOSED LEFT AND RIGHT TOP OF BANK
STA. 1+90.61 17TH AVENUE FORD CROSSING
STA. 21+85.12 INLET FROM NORTH CHANNEL
PROPOSED WATER SURFACE ELEVATION
STA. 29+53.08 15TH AVENUE
MATCH SHEET 4B, STA. 30+00.00
PROPOSED 3-8'x5'x80' RCBC'S BOX CULVERTS
EXISTING GROUND
PROPOSED CHANNEL FLOWLINE
0+00 1+50 3+00 4+50 6+00 7+50 9+00 10+50 12+00 13+50 15+00 16+50 18+00 19+50 21+00 22+50 24+00 25+50 27+00 28+50 30+00
SITE 4
SKUNK TANK WASH
IMPROVEMENTS
DESIGN FLOW = 2,810 cfs
FROM STA. 0+00 TO 21+85
DESIGN FLOW = 1,500 cfs
FROM STA. 21+85 TO 30+00
KEY TO UTILITIES
Qwest/ATT
APS
CHANNEL "4G"
CHANNEL "4E"
NOTE: THESE PLANS ARE PRELIMINARY AND ARE PROVIDED FOR PLANNING PURPOSES ONLY. THE LOCATIONS OF ALLSTRUCTURES, UTILITIES, AND R/W ARE APPROXIMATE AND ARE BASED UPON RECORD DOCUMENTS. AERIAL TOPOGRAPHY WAS PROVIDED BY THE FCDMC IN DIGITAL FORMAT.
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N
GRAPHIC SCALE
(IN FEET)
1 inch = 150 ft.
SHEET 4A
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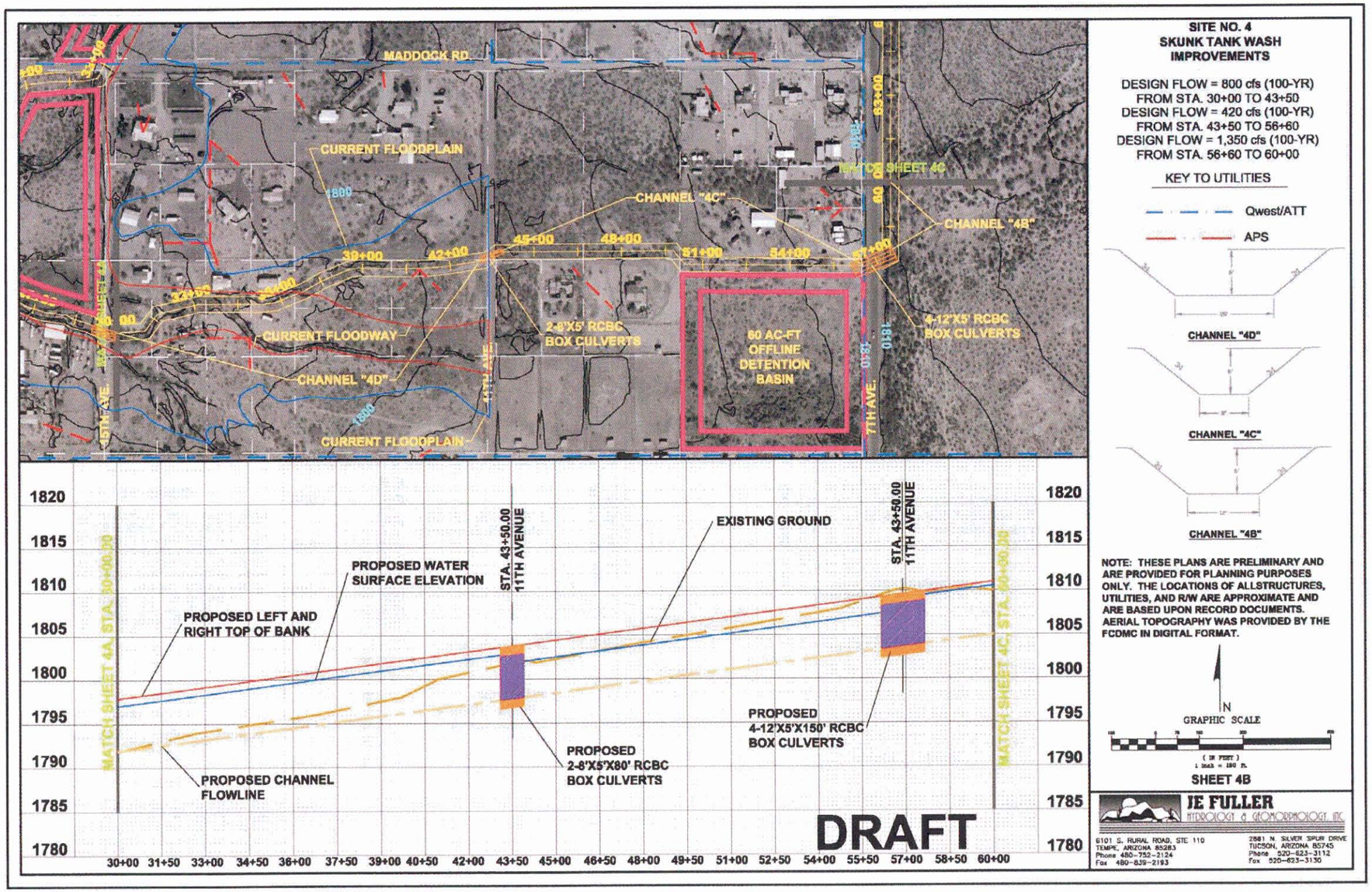
HYDROLOGY & GEOMORPHOLOGY, INC.
6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193
2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130



SITE NO. 4
SKUNK TANK WASH IMPROVEMENTS

DESIGN FLOW = 800 cfs (100-YR)
FROM STA. 30+00 TO 43+50
DESIGN FLOW = 420 cfs (100-YR)
FROM STA. 43+50 TO 56+60
DESIGN FLOW = 1,350 cfs (100-YR)
FROM STA. 56+60 TO 60+00

KEY TO UTILITIES

Qwest/ATT

APS

CHANNEL "4D"

CHANNEL "4C"

CHANNEL "4B"

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N

GRAPHIC SCALE

(IN FEET)
1 inch = 150 ft.

SHEET 4B

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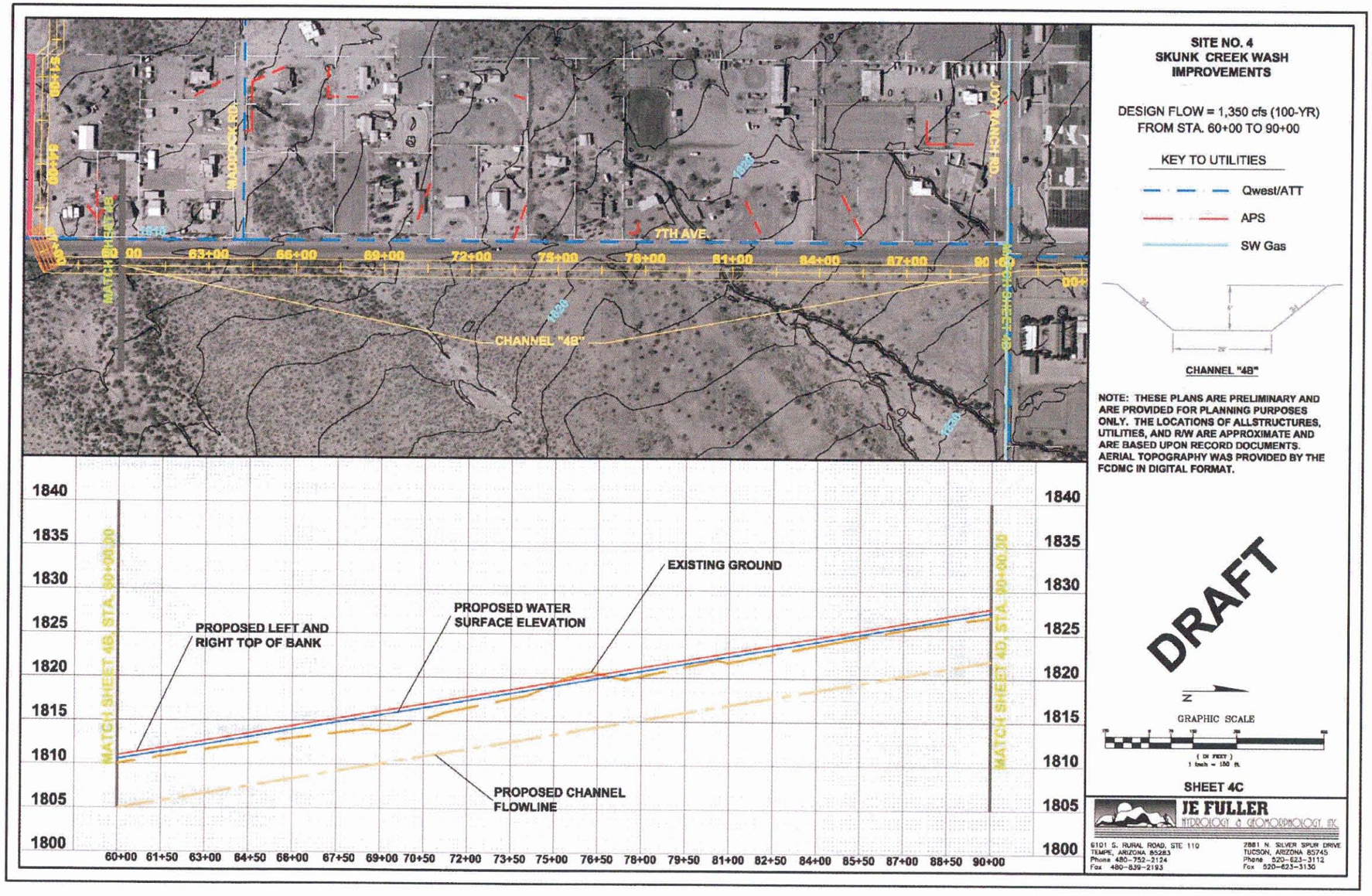
6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193

2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130


SITE NO. 4
SKUNK CREEK WASH
IMPROVEMENTS
DESIGN FLOW = 1,350 cfs (100-YR)
FROM STA. 60+00 TO 90+00
KEY TO UTILITIES
Qwest/ATT
APS
SW Gas
CHANNEL "4B"
NOTE: THESE PLANS ARE PRELIMINARY AND ARE PROVIDED FOR PLANNING PURPOSES ONLY. THE LOCATIONS OF ALLSTRUCTURES, UTILITIES, AND R/W ARE APPROXIMATE AND ARE BASED UPON RECORD DOCUMENTS. AERIAL TOPOGRAPHY WAS PROVIDED BY THE FCDMC IN DIGITAL FORMAT.
DRAFT
GRAPHIC SCALE
SHEET 4C
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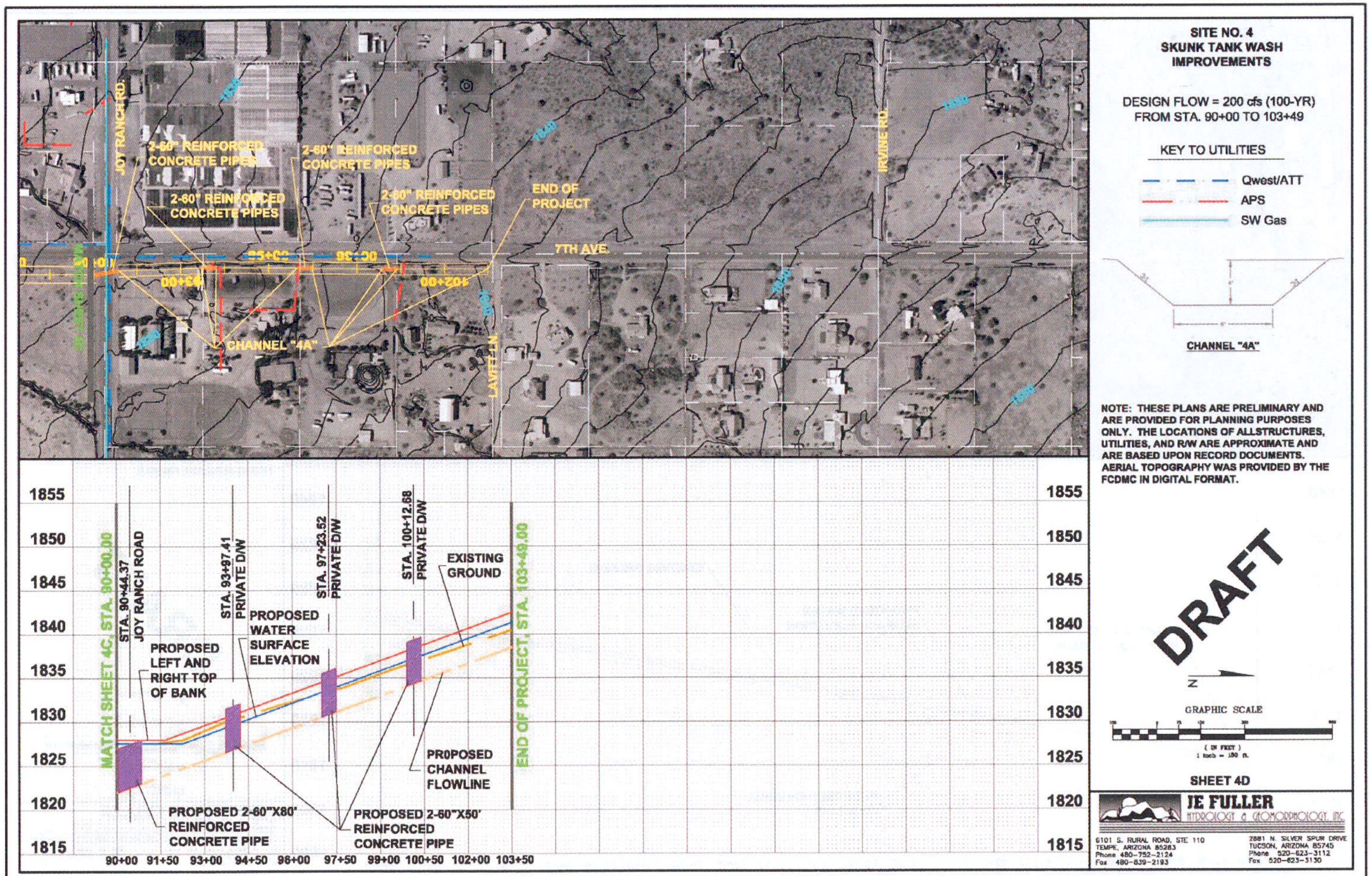
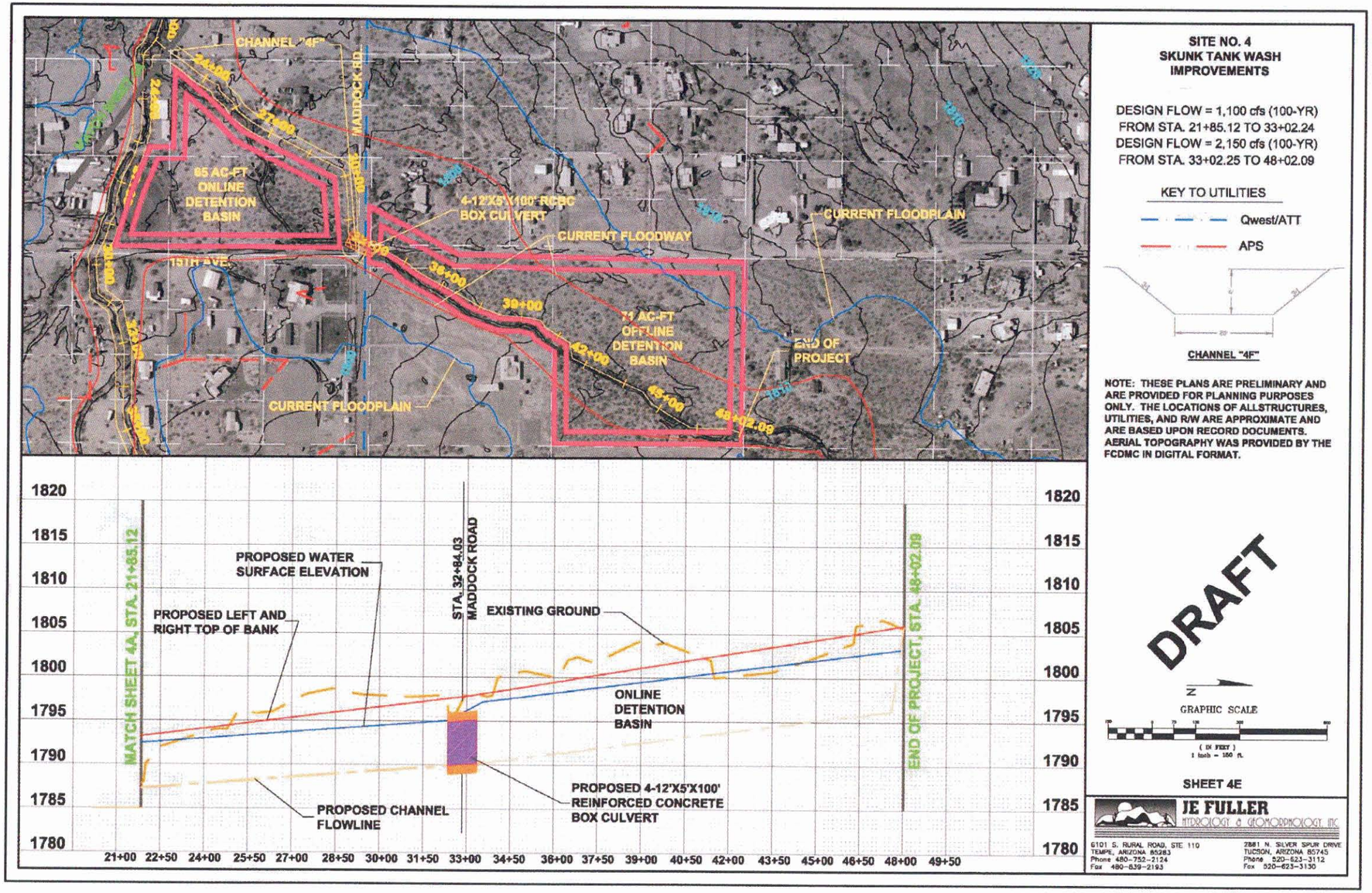
HYDROLOGY & GEOMORPHOLOGY, INC.
6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193
2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130
7TH AVE.
MADDOCK RD.
JOY RANCH RD.
CHANNEL "4B"
MATCH SHEET 4B
MATCH SHEET 4D
EXISTING GROUND
PROPOSED WATER SURFACE ELEVATION
PROPOSED LEFT AND RIGHT TOP OF BANK
PROPOSED CHANNEL FLOWLINE
1840
1835
1830
1825
1820
1815
1810
1805
1800
60+00 61+50 63+00 64+50 66+00 67+50 69+00 70+50 72+00 73+50 75+00 76+50 78+00 79+50 81+00 82+50 84+00 85+50 87+00 88+50 90+00


SITE NO. 4
SKUNK TANK WASH
IMPROVEMENTS
DESIGN FLOW = 200 cfs (100-YR)
FROM STA. 90+00 TO 103+49
KEY TO UTILITIES
Qwest/ATT
APS
SW Gas
CHANNEL "4A"
NOTE: THESE PLANS ARE PRELIMINARY AND ARE PROVIDED FOR PLANNING PURPOSES ONLY. THE LOCATIONS OF ALLSTRUCTURES, UTILITIES, AND R/W ARE APPROXIMATE AND ARE BASED UPON RECORD DOCUMENTS. AERIAL TOPOGRAPHY WAS PROVIDED BY THE FCDMC IN DIGITAL FORMAT.
DRAFT
GRAPHIC SCALE
SHEET 4D
JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
JOY RANCH RD.
2-60" REINFORCED CONCRETE PIPES
2-60" REINFORCED CONCRETE PIPES
2-60" REINFORCED CONCRETE PIPES
2-60" REINFORCED CONCRETE PIPES
END OF PROJECT
7TH AVE.
IRVINE RD.
CHANNEL "4A"
LAVITT LN
1855
1850
1845
1840
1835
1830
1825
1820
1815
MATCH SHEET 4C, STA. 90+00.00
STA. 90+44.37 JOY RANCH ROAD
STA. 93+97.41 PRIVATE D/W
STA. 97+23.52 PRIVATE D/W
STA. 100+12.68 PRIVATE D/W
END OF PROJECT, STA. 103+49.00
EXISTING GROUND
PROPOSED WATER SURFACE ELEVATION
PROPOSED LEFT AND RIGHT TOP OF BANK
PROPOSED CHANNEL FLOWLINE
PROPOSED 2-60"X80' REINFORCED CONCRETE PIPE
PROPOSED 2-60"X50' REINFORCED CONCRETE PIPE
90+00 91+50 93+00 94+50 96+00 97+50 99+00 100+50 102+00 103+50



SITE NO. 4
SKUNK TANK WASH IMPROVEMENTS

DESIGN FLOW = 1,100 cfs (100-YR)
FROM STA. 21+85.12 TO 33+02.24
DESIGN FLOW = 2,150 cfs (100-YR)
FROM STA. 33+02.25 TO 48+02.09

KEY TO UTILITIES

Qwest/ATT

APS

CHANNEL "4F"

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DRAFT

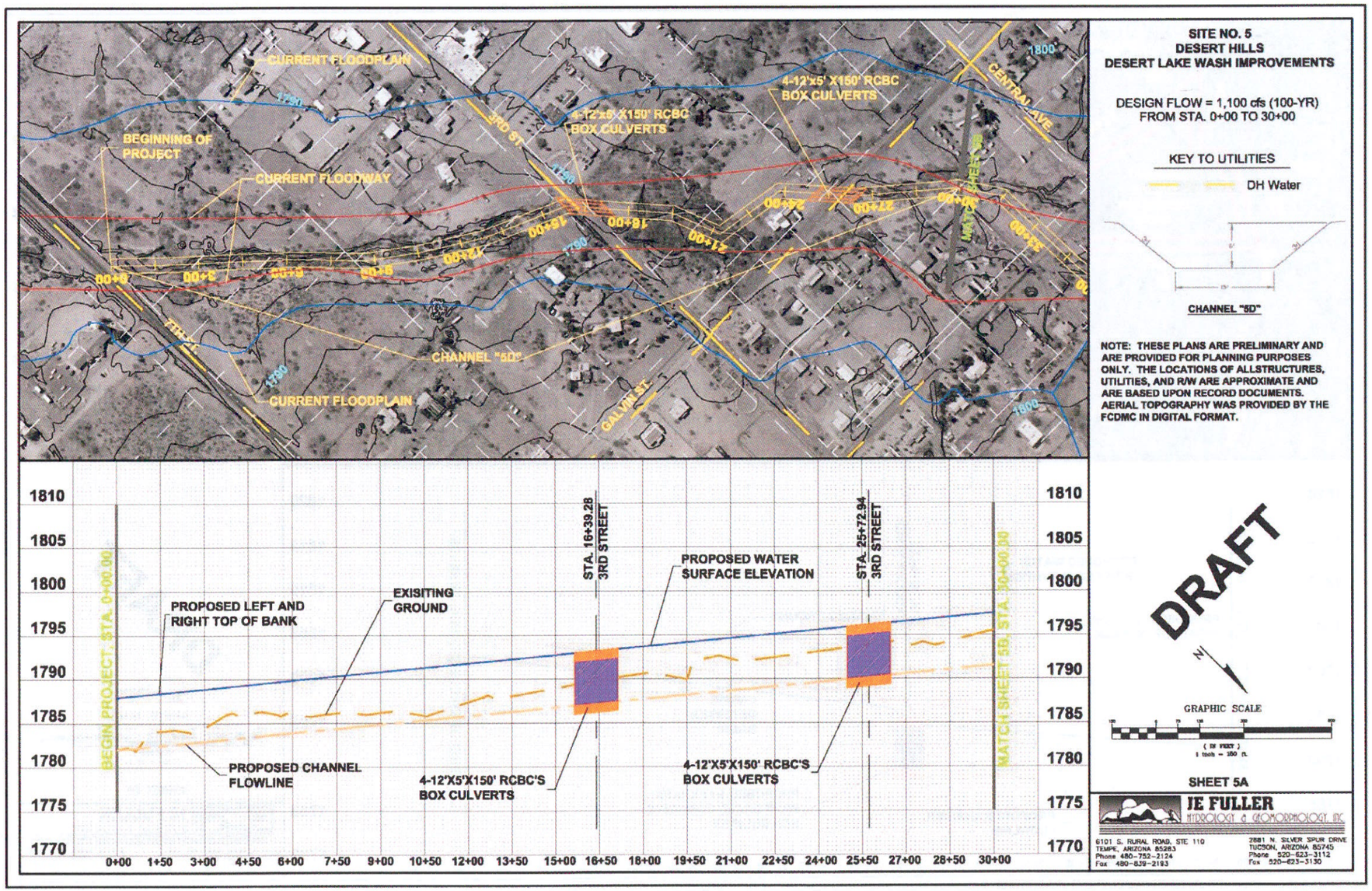
N

GRAPHIC SCALE

(IN FEET)
1 inch = 100 ft.

SHEET 4E

JE FULLER HYDROLOGY & GEOMORPHOLOGY, INC.
6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193
2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130



SITE NO. 5
DESERT HILLS
DESERT LAKE WASH IMPROVEMENTS

DESIGN FLOW = 1,100 cfs (100-YR)
FROM STA. 0+00 TO 30+00

KEY TO UTILITIES

DH Water

CHANNEL "5D"

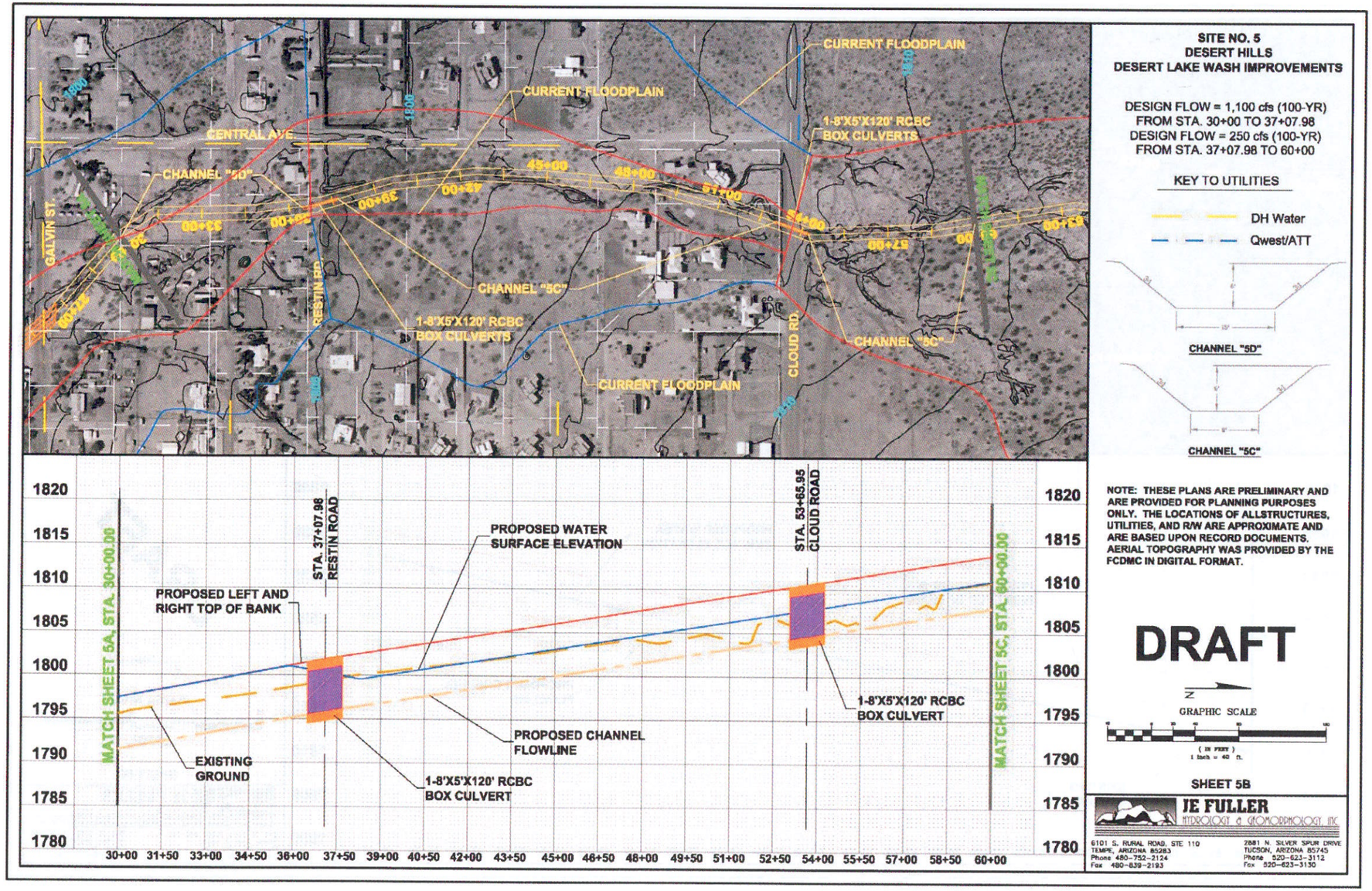
NOTE: THESE PLANS ARE PRELIMINARY AND ARE PROVIDED FOR PLANNING PURPOSES ONLY. THE LOCATIONS OF ALLSTRUCTURES, UTILITIES, AND R/W ARE APPROXIMATE AND ARE BASED UPON RECORD DOCUMENTS. AERIAL TOPOGRAPHY WAS PROVIDED BY THE FCDMC IN DIGITAL FORMAT.

DRAFT

GRAPHIC SCALE

SHEET 5A

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193
2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130



SITE NO. 5
DESERT HILLS
DESERT LAKE WASH IMPROVEMENTS

DESIGN FLOW = 1,100 cfs (100-YR)
FROM STA. 30+00 TO 37+07.98
DESIGN FLOW = 250 cfs (100-YR)
FROM STA. 37+07.98 TO 60+00

KEY TO UTILITIES

DH Water
Qwest/ATT

CHANNEL "5D"

CHANNEL "5C"

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DRAFT

N

GRAPHIC SCALE

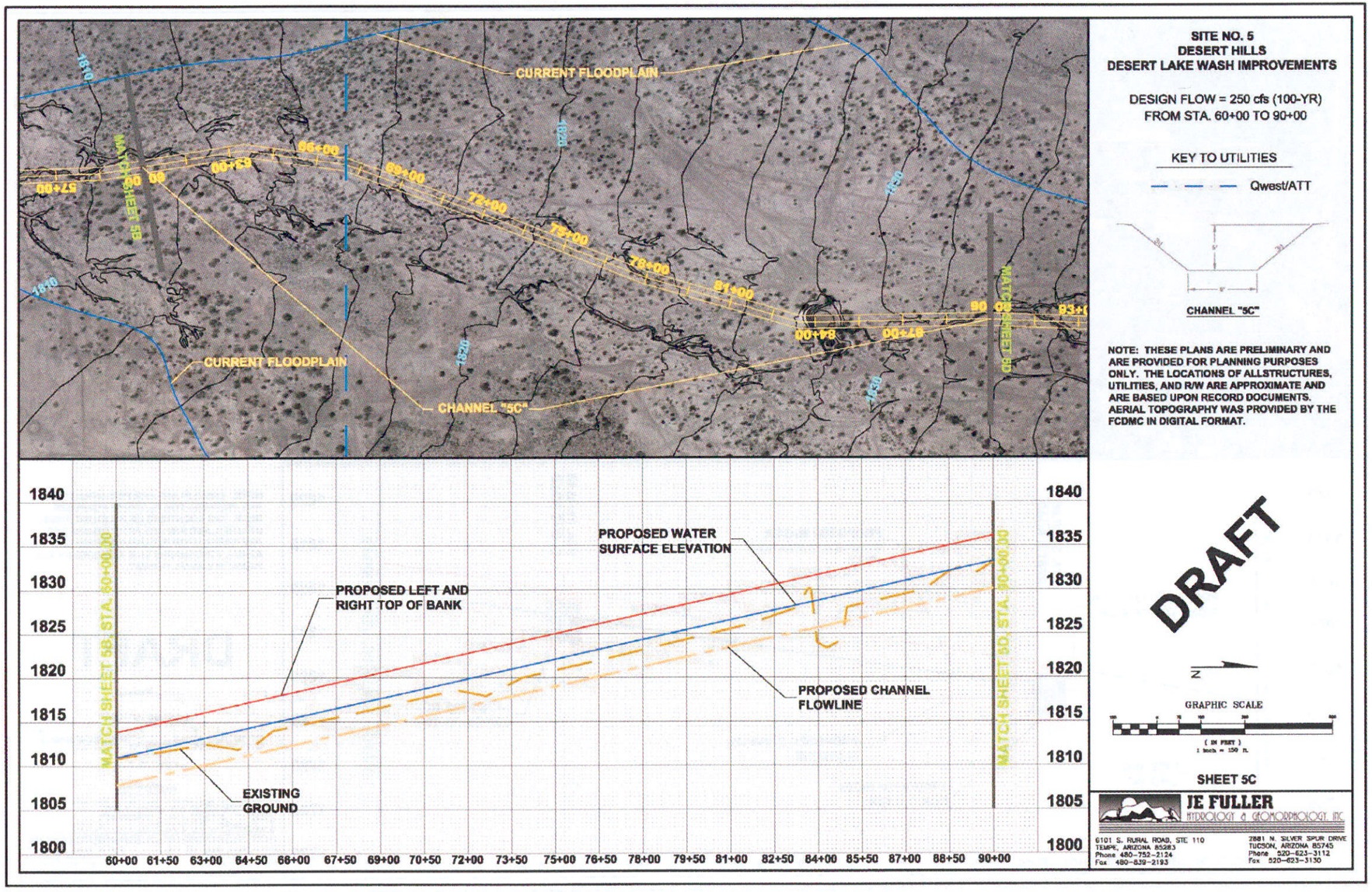
(IN FEET)
1 inch = 40 ft.

SHEET 5B

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193

2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130


CURRENT FLOODPLAIN
CURRENT FLOODPLAIN
CHANNEL "5C"
MATCH SHEET 5B
MATCH SHEET 5D
1810
1820
1830
1840
57+00
60+00
63+00
66+00
69+00
72+00
75+00
78+00
81+00
84+00
87+00
90
93+
1840
1835
1830
1825
1820
1815
1810
1805
1800
MATCH SHEET 5B, STA. 60+00.00
MATCH SHEET 5D, STA. 90+00.00
PROPOSED WATER SURFACE ELEVATION
PROPOSED LEFT AND RIGHT TOP OF BANK
PROPOSED CHANNEL FLOWLINE
EXISTING GROUND
60+00 61+50 63+00 64+50 66+00 67+50 69+00 70+50 72+00 73+50 75+00 76+50 78+00 79+50 81+00 82+50 84+00 85+50 87+00 88+50 90+00
SITE NO. 5
DESERT HILLS
DESERT LAKE WASH IMPROVEMENTS
DESIGN FLOW = 250 cfs (100-YR)
FROM STA. 60+00 TO 90+00
KEY TO UTILITIES
Qwest/ATT
CHANNEL "5C"
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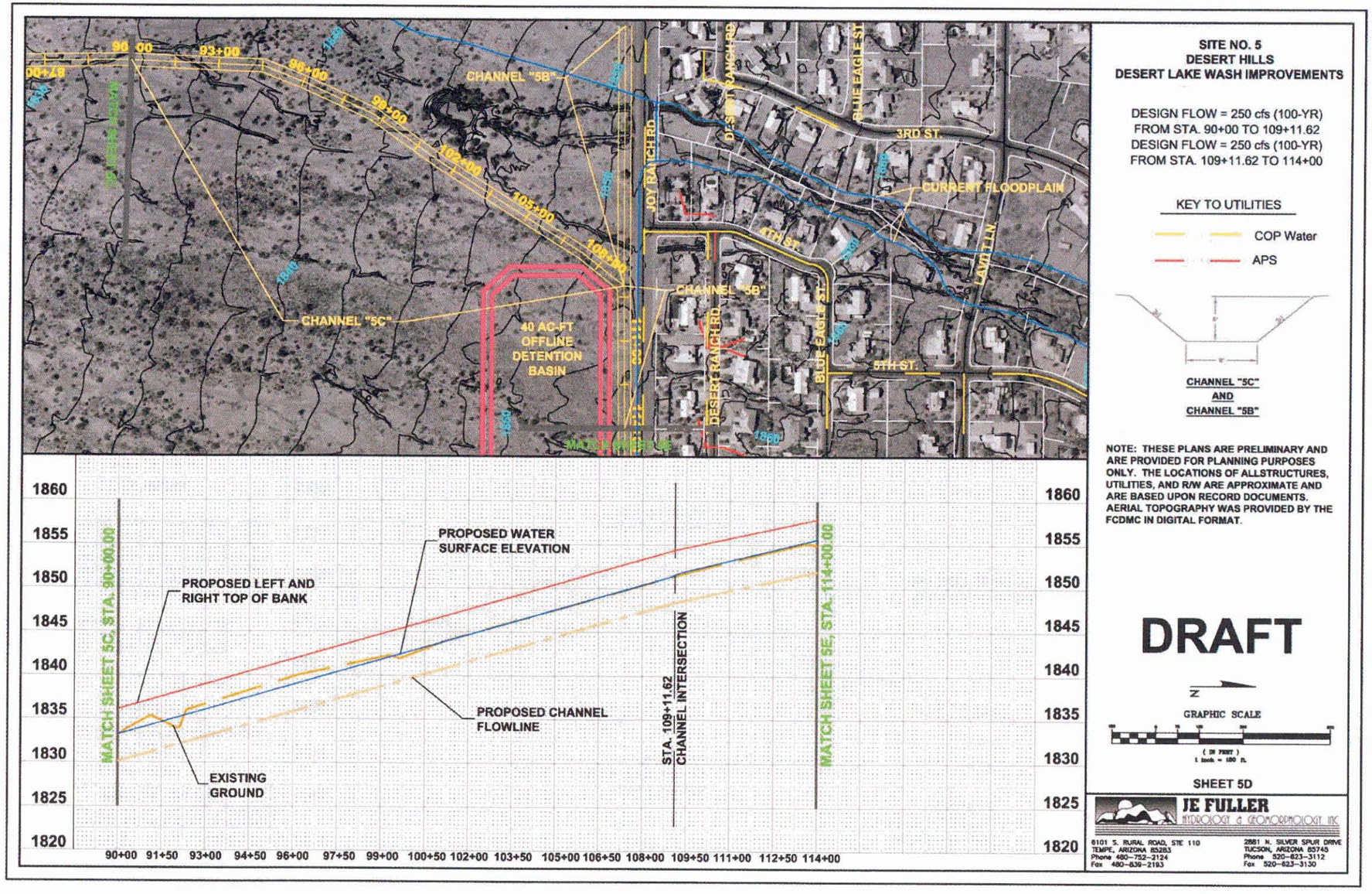
DRAFT
N
GRAPHIC SCALE
(IN FEET)
1 inch = 150 ft.
SHEET 5C
JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193
2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130



SITE NO. 5
DESERT HILLS
DESERT LAKE WASH IMPROVEMENTS

DESIGN FLOW = 250 cfs (100-YR)
FROM STA. 90+00 TO 109+11.62
DESIGN FLOW = 250 cfs (100-YR)
FROM STA. 109+11.62 TO 114+00

KEY TO UTILITIES

COP Water

APS

CHANNEL "5C"
AND
CHANNEL "5B"

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DRAFT

N

GRAPHIC SCALE

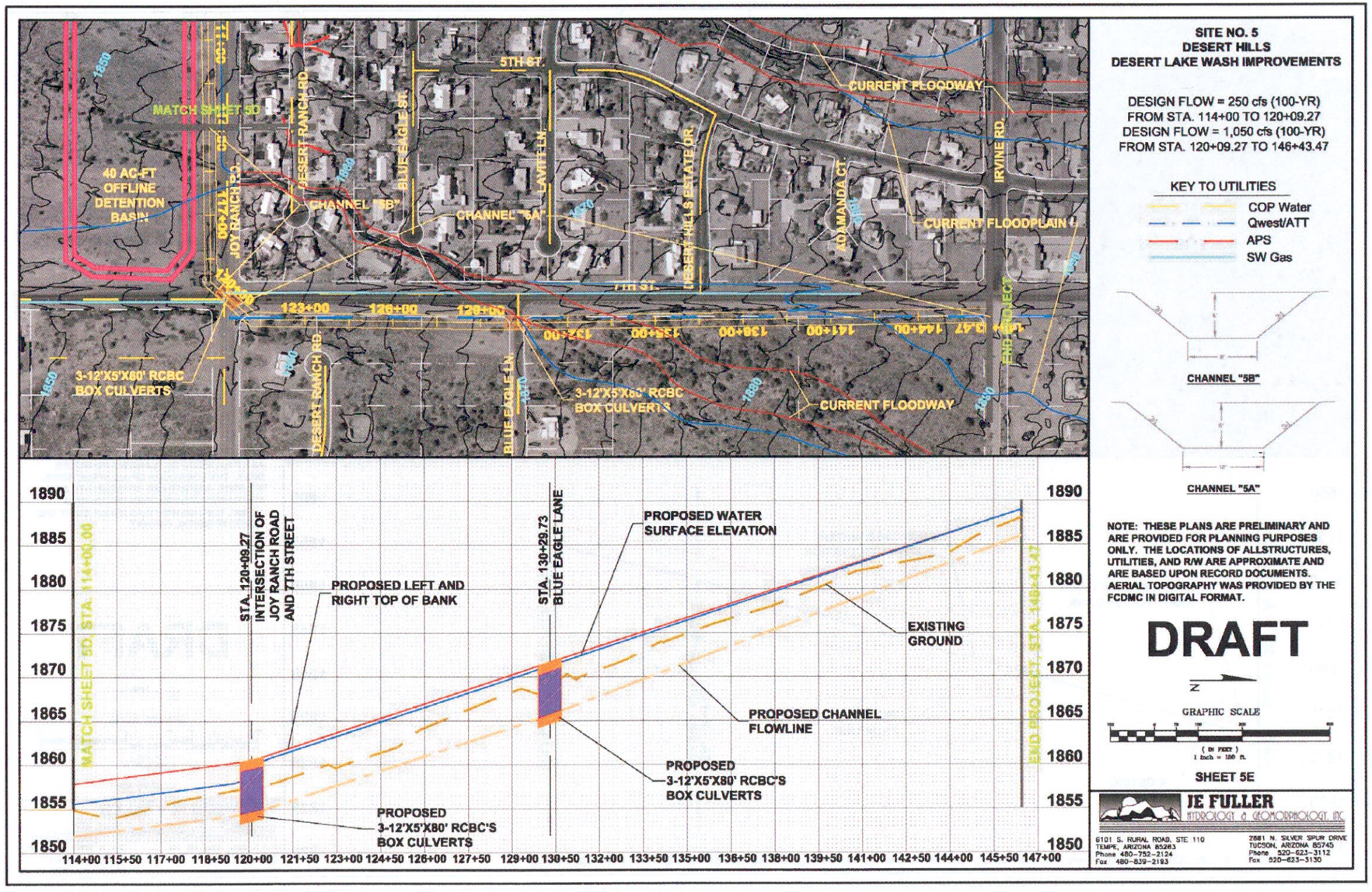
(IN FEET)
1 inch = 100 ft.

SHEET 5D

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193

2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130


MATCH SHEET 5D
40 AC-FT OFFLINE DETENTION BASIN
DESERT RANCH RD.
JOY RANCH RD.
BLUE EAGLE LN.
LAVIER LN.
5TH ST.
7TH ST.
CHANNEL "5B"
CHANNEL "5A"
DESERT HILLS ESTATE DR.
40 MANDA CT.
IRVINE RD.
CURRENT FLOODWAY
CURRENT FLOODPLAIN
3-12'X5'X80' RCBC BOX CULVERTS
END PROJECT
123+00
126+00
129+00
132+00
135+00
138+00
141+00
144+00
147+00
1850
1855
1860
1865
1870
1875
1880
1885
1890
MATCH SHEET 5D, STA. 114+00.00
STA. 120+09.27 INTERSECTION OF JOY RANCH ROAD AND 7TH STREET
STA. 130+29.73 BLUE EAGLE LANE
END PROJECT, STA. 146+43.47
PROPOSED LEFT AND RIGHT TOP OF BANK
PROPOSED WATER SURFACE ELEVATION
EXISTING GROUND
PROPOSED CHANNEL FLOWLINE
PROPOSED 3-12'X5'X80' RCBC'S BOX CULVERTS
PROPOSED 3-12'X5'X80' RCBC'S BOX CULVERTS
114+00 115+50 117+00 118+50 120+00 121+50 123+00 124+50 126+00 127+50 129+00 130+50 132+00 133+50 135+00 136+50 138+00 139+50 141+00 142+50 144+00 145+50 147+00
SITE NO. 5
DESERT HILLS
DESERT LAKE WASH IMPROVEMENTS
DESIGN FLOW = 250 cfs (100-YR)
FROM STA. 114+00 TO 120+09.27
DESIGN FLOW = 1,050 cfs (100-YR)
FROM STA. 120+09.27 TO 146+43.47
KEY TO UTILITIES
COP Water
Qwest/ATT
APS
SW Gas
CHANNEL "5B"
CHANNEL "5A"
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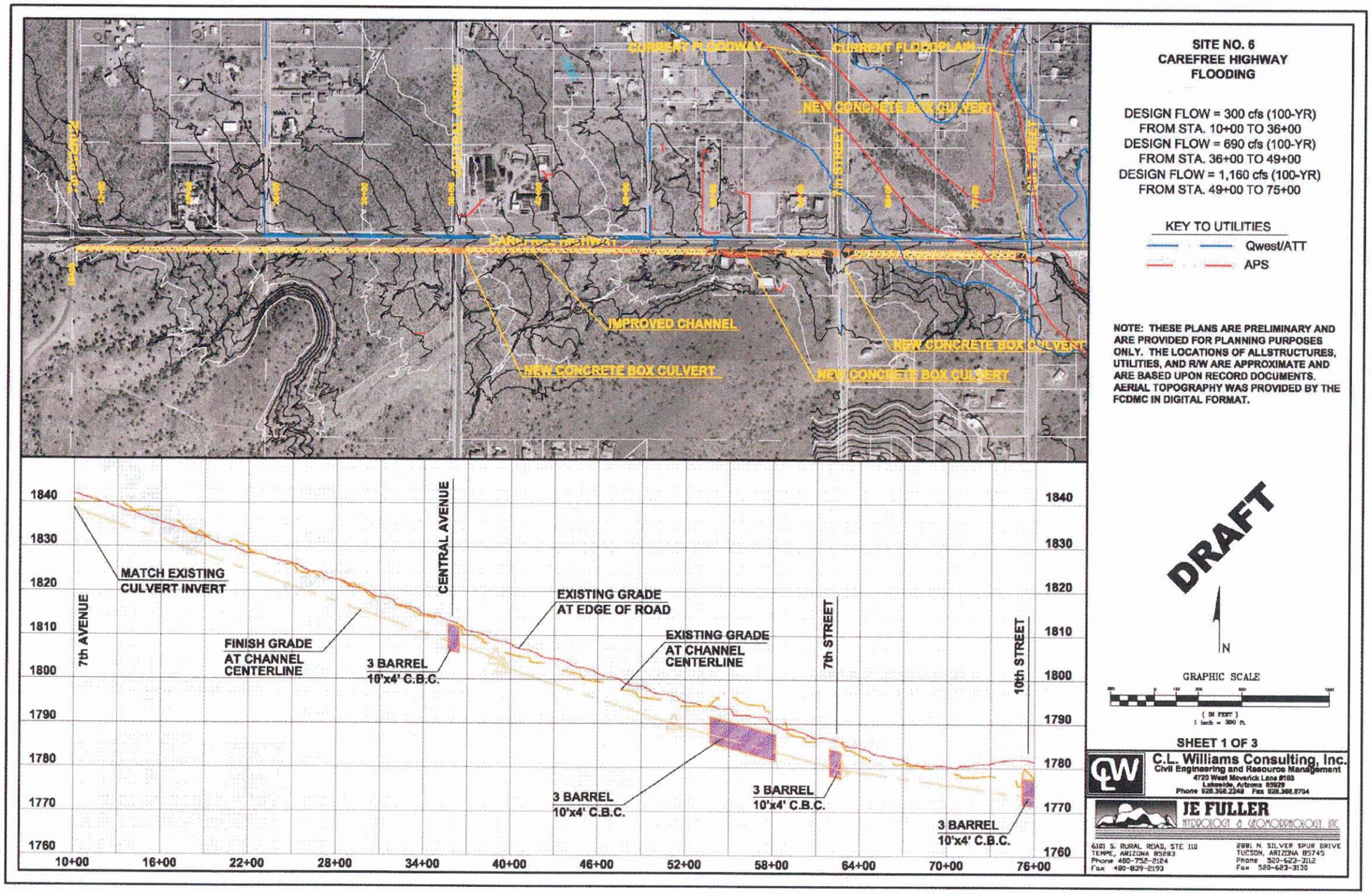
DRAFT
N
GRAPHIC SCALE
(IN FEET)
1 inch = 100 ft.
SHEET 5E
JE FULLER HYDROLOGY & GEOMORPHOLOGY, INC.
6101 S. RURAL ROAD, STE. 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193
2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130



SITE NO. 6
CAREFREE HIGHWAY
FLOODING

DESIGN FLOW = 300 cfs (100-YR)
FROM STA. 10+00 TO 36+00
DESIGN FLOW = 690 cfs (100-YR)
FROM STA. 36+00 TO 49+00
DESIGN FLOW = 1,160 cfs (100-YR)
FROM STA. 49+00 TO 75+00

KEY TO UTILITIES
Qwest/ATT
APS

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DRAFT

N

GRAPHIC SCALE

(IN FEET)
1 inch = 300 ft.

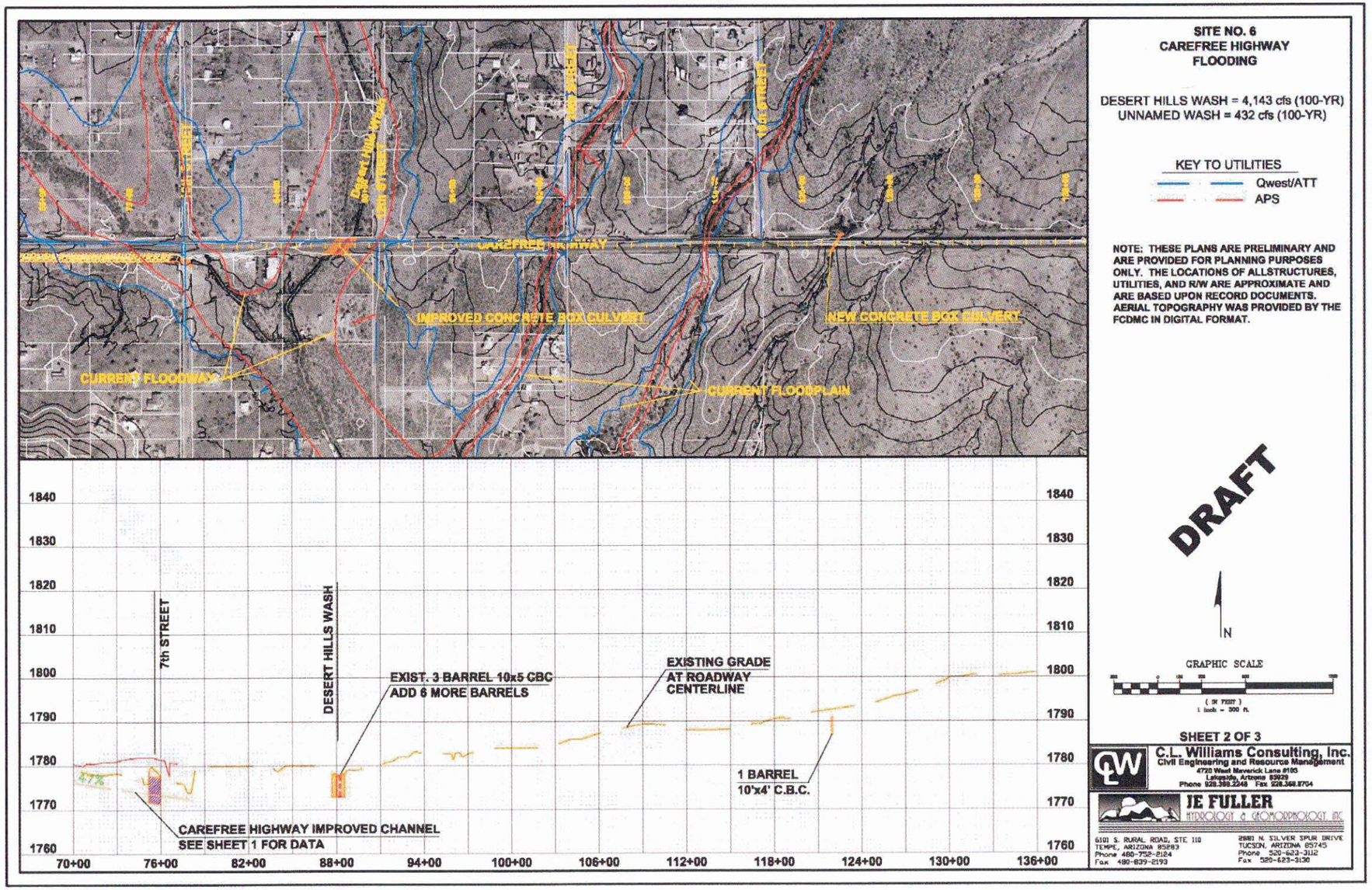
SHEET 1 OF 3

C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4720 West Maverick Lane #103
Lakeside, Arizona 85929
Phone 928.368.2248 Fax 928.368.8704

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-753-2124
Fax 480-839-2193

2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130


CAREFREE HIGHWAY
7th STREET
DESERT HILLS WASH
IMPROVED CONCRETE BOX CULVERT
NEW CONCRETE BOX CULVERT
CURRENT FLOODWAY
CURRENT FLOODPLAIN
1840
1830
1820
1810
1800
1790
1780
1770
1760
7th STREET
DESERT HILLS WASH
EXIST. 3 BARREL 10x5 CBC
ADD 6 MORE BARRELS
EXISTING GRADE
AT ROADWAY
CENTERLINE
1 BARREL
10'x4' C.B.C.
CAREFREE HIGHWAY IMPROVED CHANNEL
SEE SHEET 1 FOR DATA
70+00
76+00
82+00
88+00
94+00
100+00
106+00
112+00
118+00
124+00
130+00
136+00
SITE NO. 6
CAREFREE HIGHWAY
FLOODING
DESERT HILLS WASH = 4,143 cfs (100-YR)
UNNAMED WASH = 432 cfs (100-YR)
KEY TO UTILITIES
Qwest/ATT
APS
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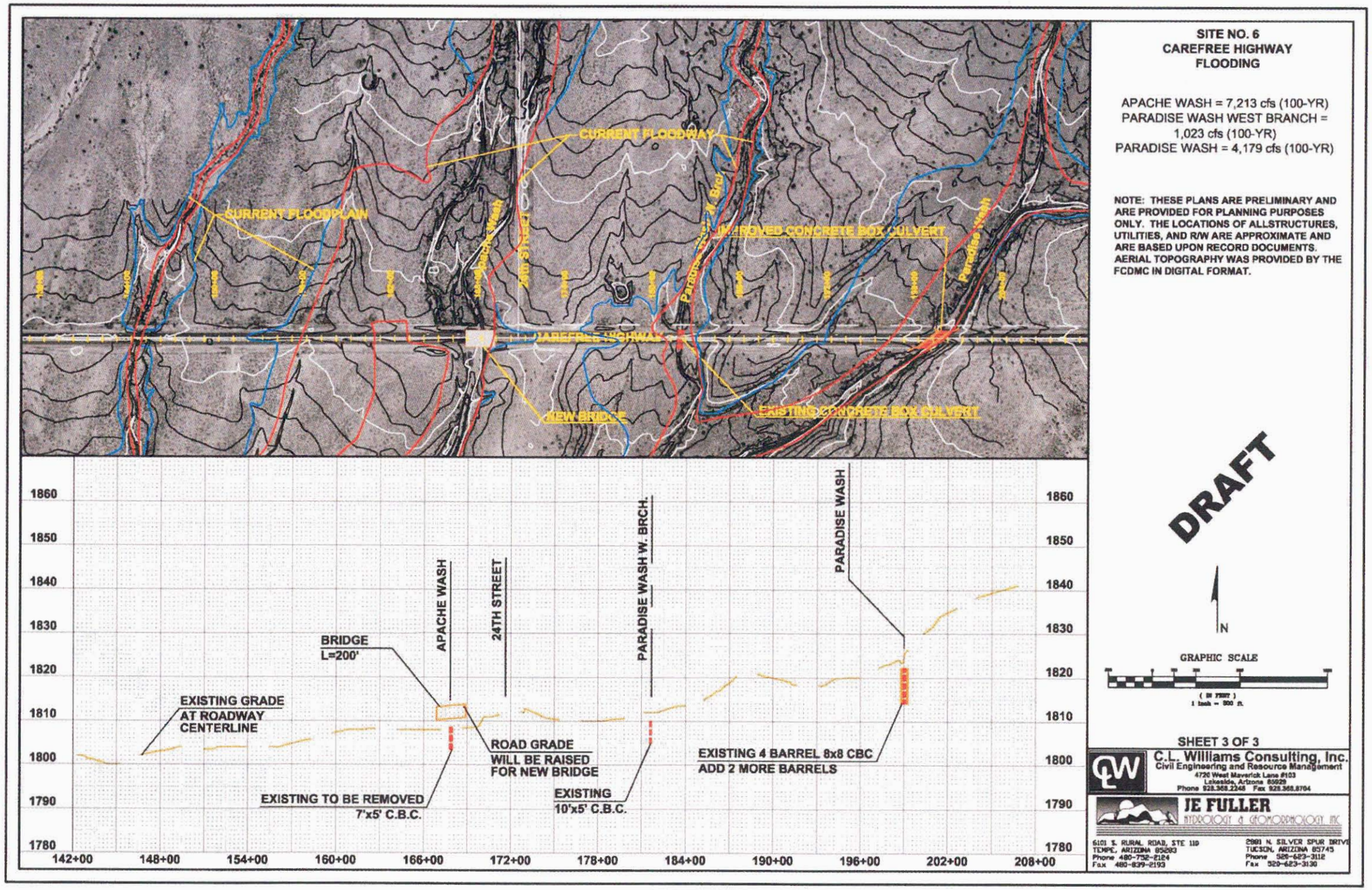
DRAFT
N
GRAPHIC SCALE
SHEET 2 OF 3
C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4720 West Maverick Lane #185
Lakeside, Arizona 85929
Phone 928.368.2248 Fax 928.368.8704
JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193
2880 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130



SITE NO. 6
CAREFREE HIGHWAY
FLOODING

APACHE WASH = 7,213 cfs (100-YR)
PARADISE WASH WEST BRANCH = 1,023 cfs (100-YR)
PARADISE WASH = 4,179 cfs (100-YR)

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DRAFT

N

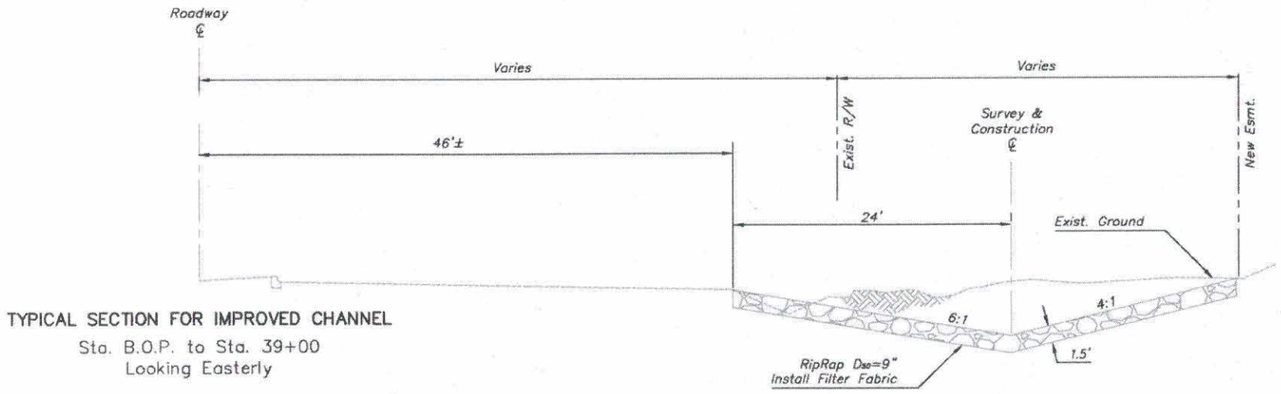
GRAPHIC SCALE

SHEET 3 OF 3

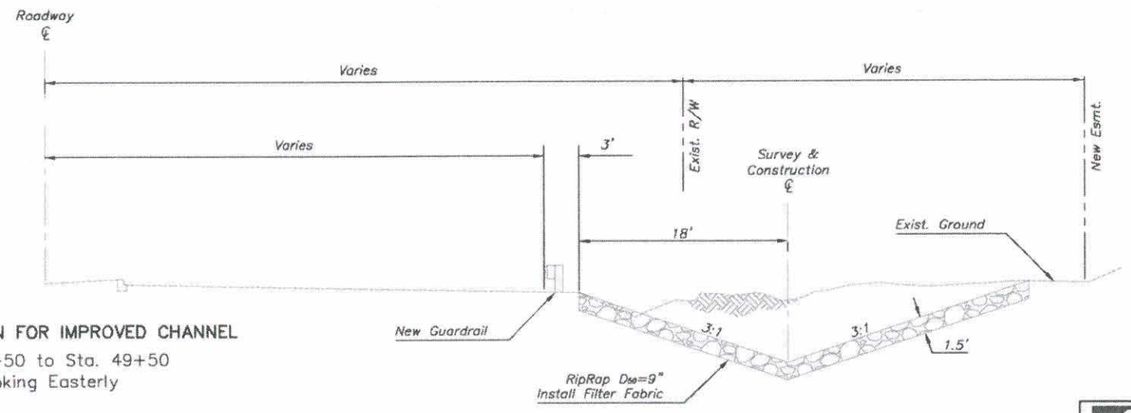
C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4726 West Maverick Lane #103
Lakeside, Arizona 85929
Phone 928.368.2348 Fax 928.368.8704

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193

2991 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130



TYPICAL SECTION FOR IMPROVED CHANNEL
Sta. B.O.P. to Sta. 39+00
Looking Easterly



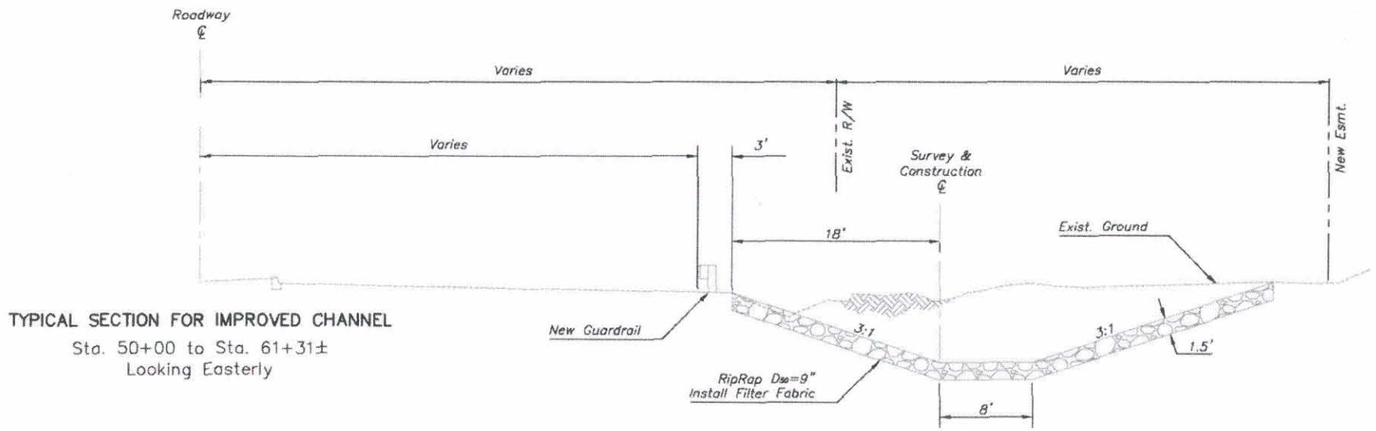
TYPICAL SECTION FOR IMPROVED CHANNEL
Sta. 39+50 to Sta. 49+50
Looking Easterly

DRAFT

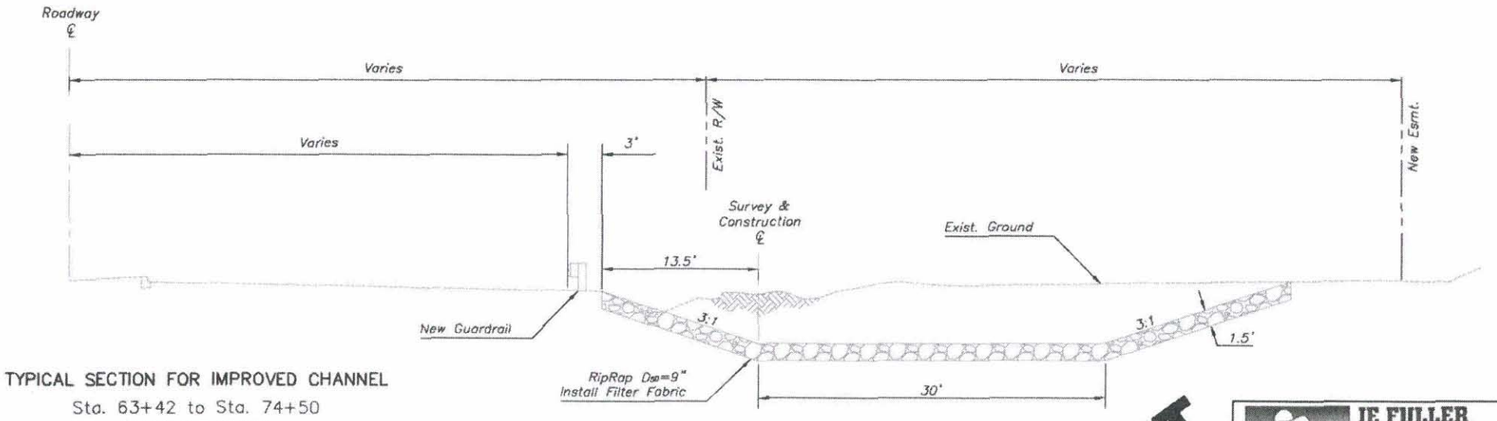
JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
8181 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-9126
Fax 480-539-2183
3891 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3139

C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4720 West Maverick Lane #103
Lakeside, Arizona 85929
Phone 928.368.2248 Fax 928.368.8704

NOTE: ESTIMATED FROM AERIAL PHOTO & GIS DATA



TYPICAL SECTION FOR IMPROVED CHANNEL
Sta. 50+00 to Sta. 61+31±
Looking Easterly

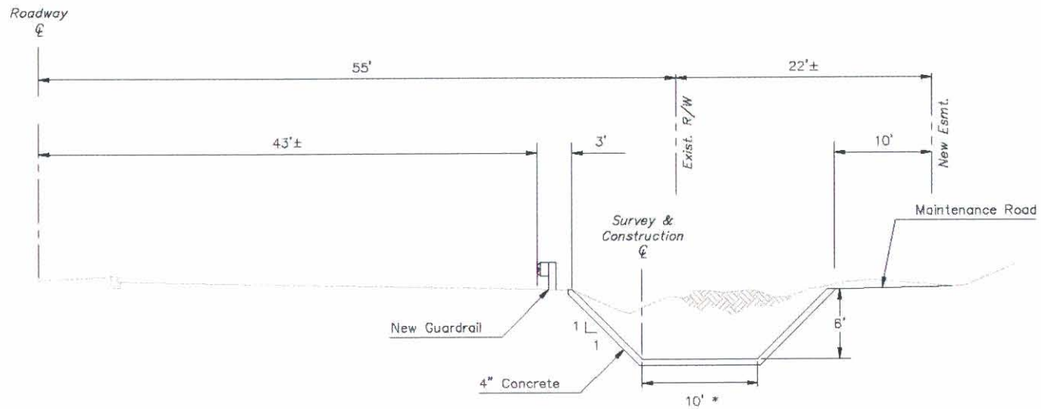


TYPICAL SECTION FOR IMPROVED CHANNEL
Sta. 63+42 to Sta. 74+50
Looking Easterly

NOTE: ESTIMATED FROM AERIAL PHOTO & GIS DATA

DRAFT

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
8101 S. RUBIK ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-9124
Fax 480-839-2193
3991 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85749
Phone 520-623-3112
Fax 520-623-3139
C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4720 West Maverick Lane #103
Lakeside, Arizona 85929
Phone 928.368.2248 Fax 928.368.8704



TYPICAL SECTION FOR CONCRETE CHANNEL

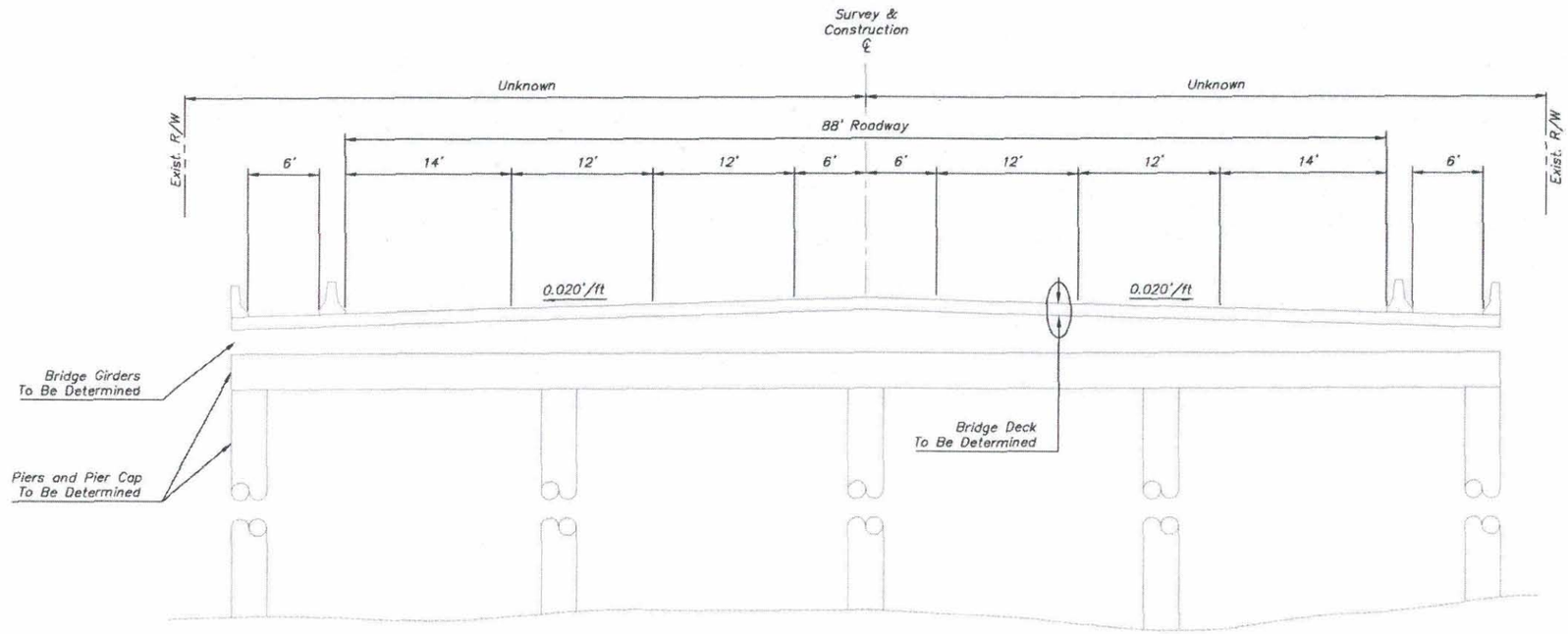
Rural Principal Arterial Road
* 14' From Sta. 66+46.29 to E.O.P.
Looking Easterly

NOTE: ESTIMATED FROM AERIAL PHOTO

DRAFT

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4720 West Maverick Lane #103
Lakeside, Arizona 85929
Phone 928.368.2248 Fax 928.368.8704



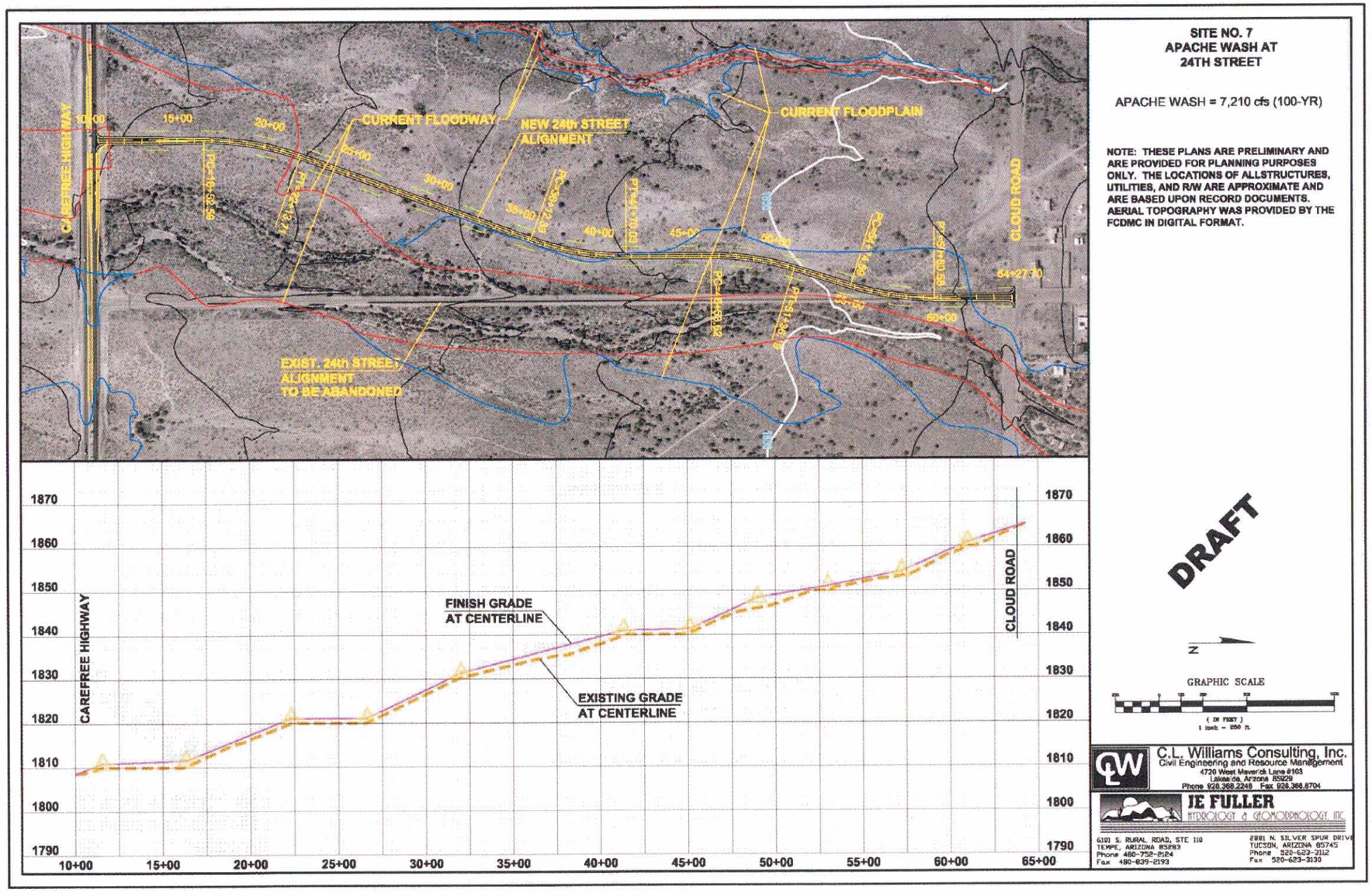
TYPICAL SECTION FOR BRIDGE
Rural Collector Road (at Section Line)

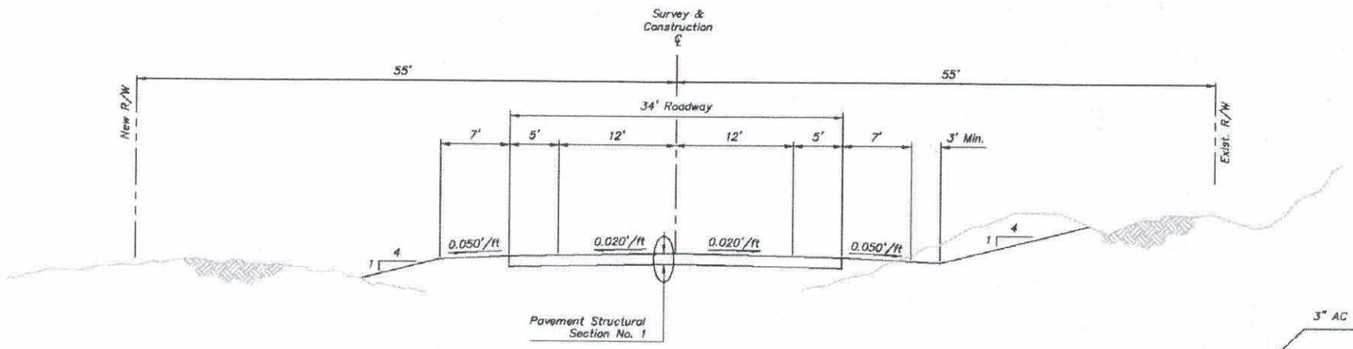
NOTE: PER DISCUSSIONS WITH MCDOT STAFF

DRAFT

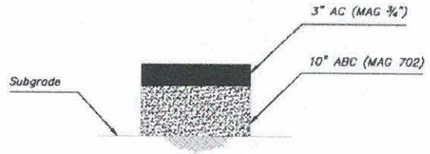
JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
8101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2183
2851 N. SEWER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3139

C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4720 West Maverick Lane #103
Lakeside, Arizona 85929
Phone 928.368.2248 Fax 928.368.8704

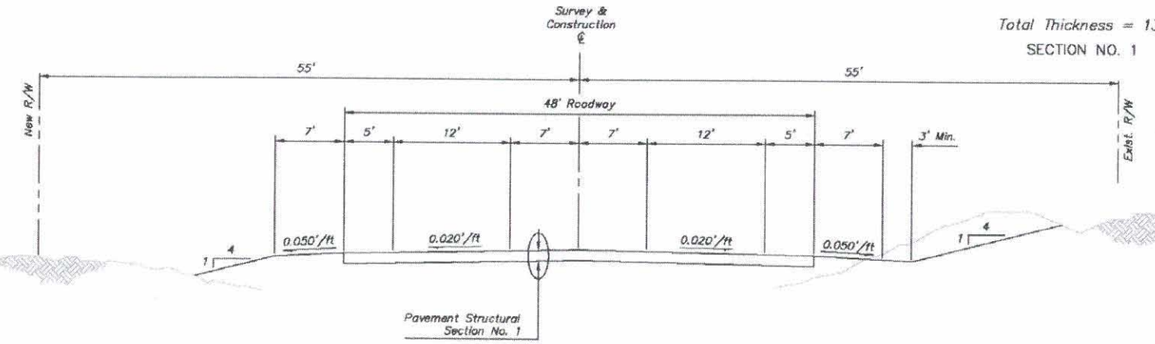

CAREFREE HIGHWAY
CLOUD ROAD
CURRENT FLOODWAY
NEW 24th STREET ALIGNMENT
CURRENT FLOODPLAIN
EXIST. 24th STREET ALIGNMENT TO BE ABANDONED
10+00
15+00
20+00
25+00
30+00
35+00
40+00
45+00
50+00
55+00
60+00
64+27.30
1870
1860
1850
1840
1830
1820
1810
1800
1790
FINISH GRADE AT CENTERLINE
EXISTING GRADE AT CENTERLINE
SITE NO. 7
APACHE WASH AT
24TH STREET
APACHE WASH = 7,210 cfs (100-YR)
NOTE: THESE PLANS ARE PRELIMINARY AND ARE PROVIDED FOR PLANNING PURPOSES ONLY. THE LOCATIONS OF ALLSTRUCTURES, UTILITIES, AND R/W ARE APPROXIMATE AND ARE BASED UPON RECORD DOCUMENTS. AERIAL TOPOGRAPHY WAS PROVIDED BY THE FCDMC IN DIGITAL FORMAT.
DRAFT
N
GRAPHIC SCALE
C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4720 West Maverick Lane #103
Lakeside, Arizona 85929
Phone 928.368.2248 Fax 928.368.8704
JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-8124
Fax 480-839-2193
2891 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130



TYPICAL SECTION
Rural Collector Road (at Section Line)
NOT TO SCALE



Total Thickness = 13"
SECTION NO. 1



TYPICAL SECTION FOR LEFT TURN LANE
Rural Collector Road (at Section Line)
NOT TO SCALE

NOTE: PER MCDOT 93 ROADWAY DESIGN MANUAL

SITE NO. 7
APACHE WASH AT
24TH STREET

TYPICAL SECTIONS

NOTE: THESE PLANS ARE PRELIMINARY AND ARE PROVIDED FOR PLANNING PURPOSES ONLY. THE LOCATIONS OF ALL STRUCTURES, UTILITIES, AND R/W ARE APPROXIMATE AND ARE BASED UPON RECORD DOCUMENTS. AERIAL TOPOGRAPHY WAS PROVIDED BY THE FCDMC IN DIGITAL FORMAT.

DRAFT

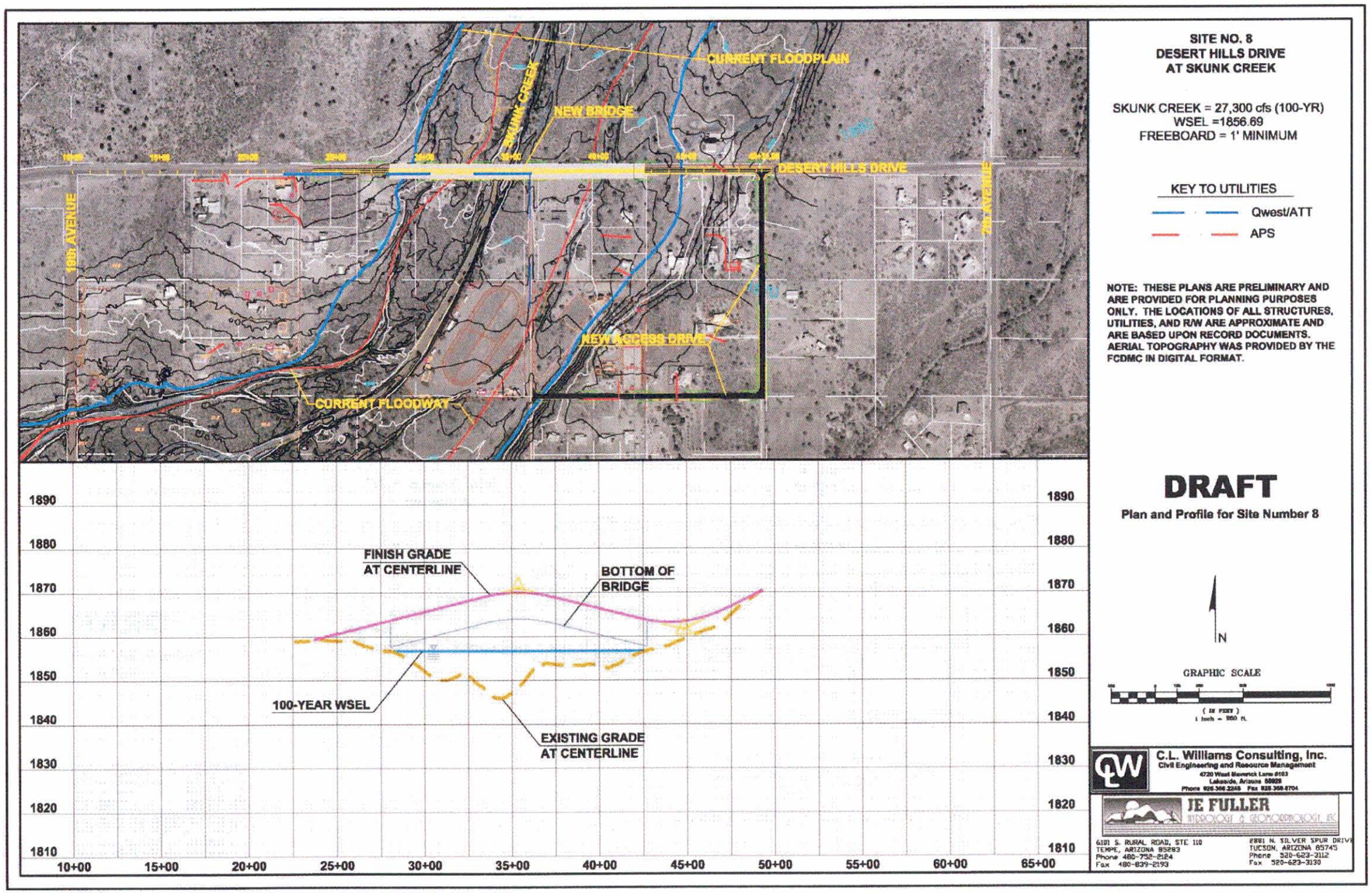
Typical Cross Sections for Site Number 7

C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4720 West Neverlok Lane (P167)
Lakeside, Arizona 85929
Phone 928.368.2246 Fax 928.368.5784

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

8181 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
PHONE 480-752-2124
FAX 480-839-2183

2891 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
PHONE 520-623-3112
FAX 520-623-3136


CURRENT FLOODPLAIN
SKUNK CREEK
NEW BRIDGE
DESERT HILLS DRIVE
107th AVENUE
NEW ACCESS DRIVE
CURRENT FLOODWAY
1890
1880
1870
1860
1850
1840
1830
1820
1810
10+00
15+00
20+00
25+00
30+00
35+00
40+00
45+00
50+00
55+00
60+00
65+00
FINISH GRADE AT CENTERLINE
BOTTOM OF BRIDGE
100-YEAR WSEL
EXISTING GRADE AT CENTERLINE
SITE NO. 8
DESERT HILLS DRIVE
AT SKUNK CREEK
SKUNK CREEK = 27,300 cfs (100-YR)
WSEL =1856.69
FREEBOARD = 1' MINIMUM
KEY TO UTILITIES
Qwest/ATT
APS
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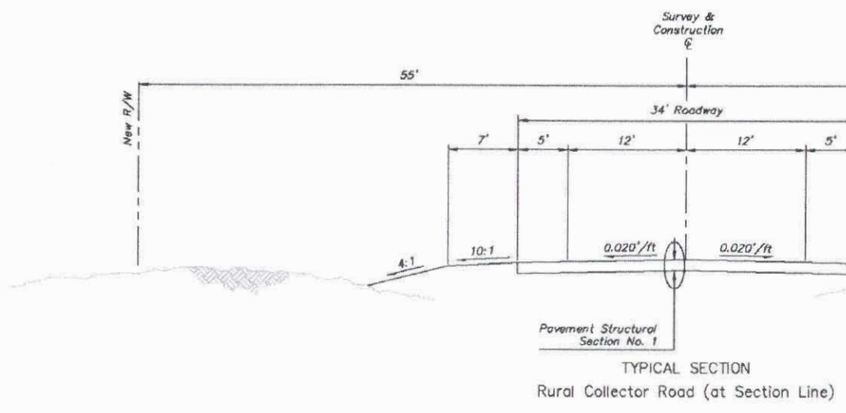
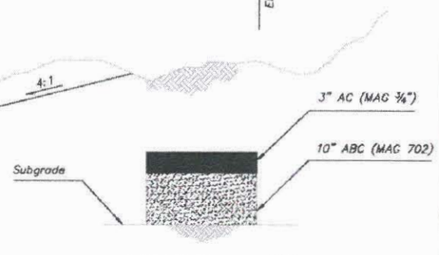
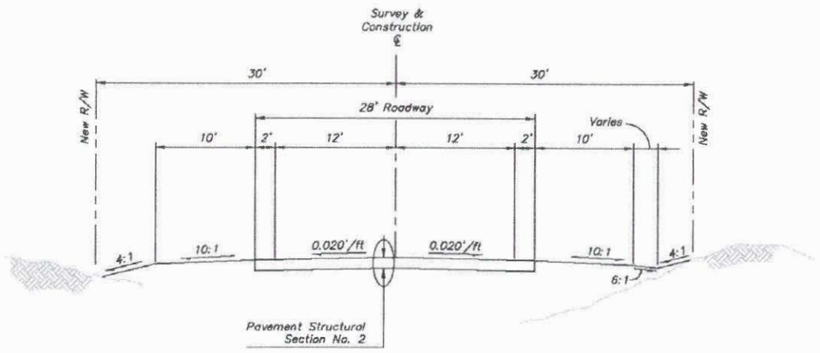
DRAFT
Plan and Profile for Site Number 8
N
GRAPHIC SCALE
C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.



TYPICAL SECTION
Rural Collector Road (at Section Line)



Total Thickness = 13"
SECTION NO. 1



TYPICAL SECTION
Rural Local Road

Total Thickness = 8"
SECTION NO. 2

SITE NO. 8
DESERT HILLS DRIVE
AT SKUNK CREEK

TYPICAL SECTIONS

NOTE: THESE PLANS ARE PRELIMINARY AND ARE PROVIDED FOR PLANNING PURPOSES ONLY. THE LOCATIONS OF ALL STRUCTURES, UTILITIES, AND R/W ARE APPROXIMATE AND ARE BASED UPON RECORD DOCUMENTS. AERIAL TOPOGRAPHY WAS PROVIDED BY THE FCDMC IN DIGITAL FORMAT.

DRAFT

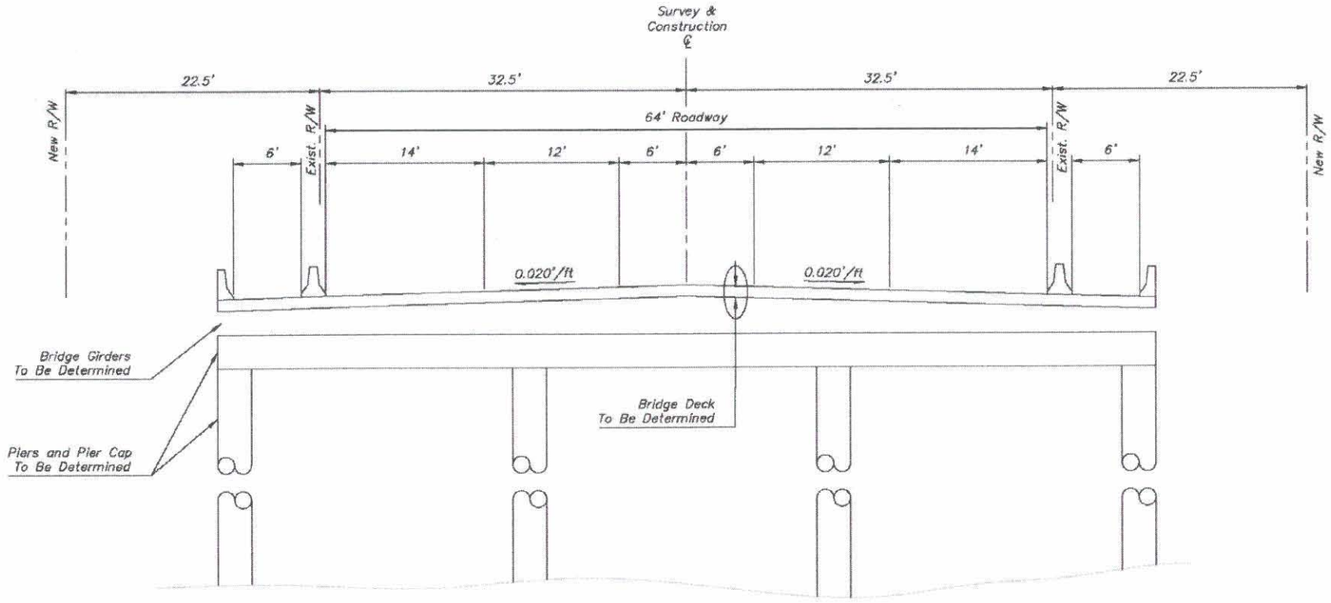
Typical Sections for Site Number 8 (Sheet 8A)

C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4720 West Maverick Lane #183
Lakeside, Arizona 85929
Phone 928.368.2345 Fax 928.368.8704

JE FULLER HYDROLOGY & GEOMORPHOLOGY, INC.

8101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
PHONE 480-752-2124
FAX 480-838-2193

2891 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
PHONE 520-623-2113
FAX 520-623-3120



TYPICAL SECTION FOR BRIDGE
Rural Collector Road (at Section Line)

NOTE: PER DISCUSSIONS WITH MCDOT STAFF

SITE NO. 8
DESERT HILLS DRIVE
AT SKUNK CREEK

TYPICAL SECTIONS

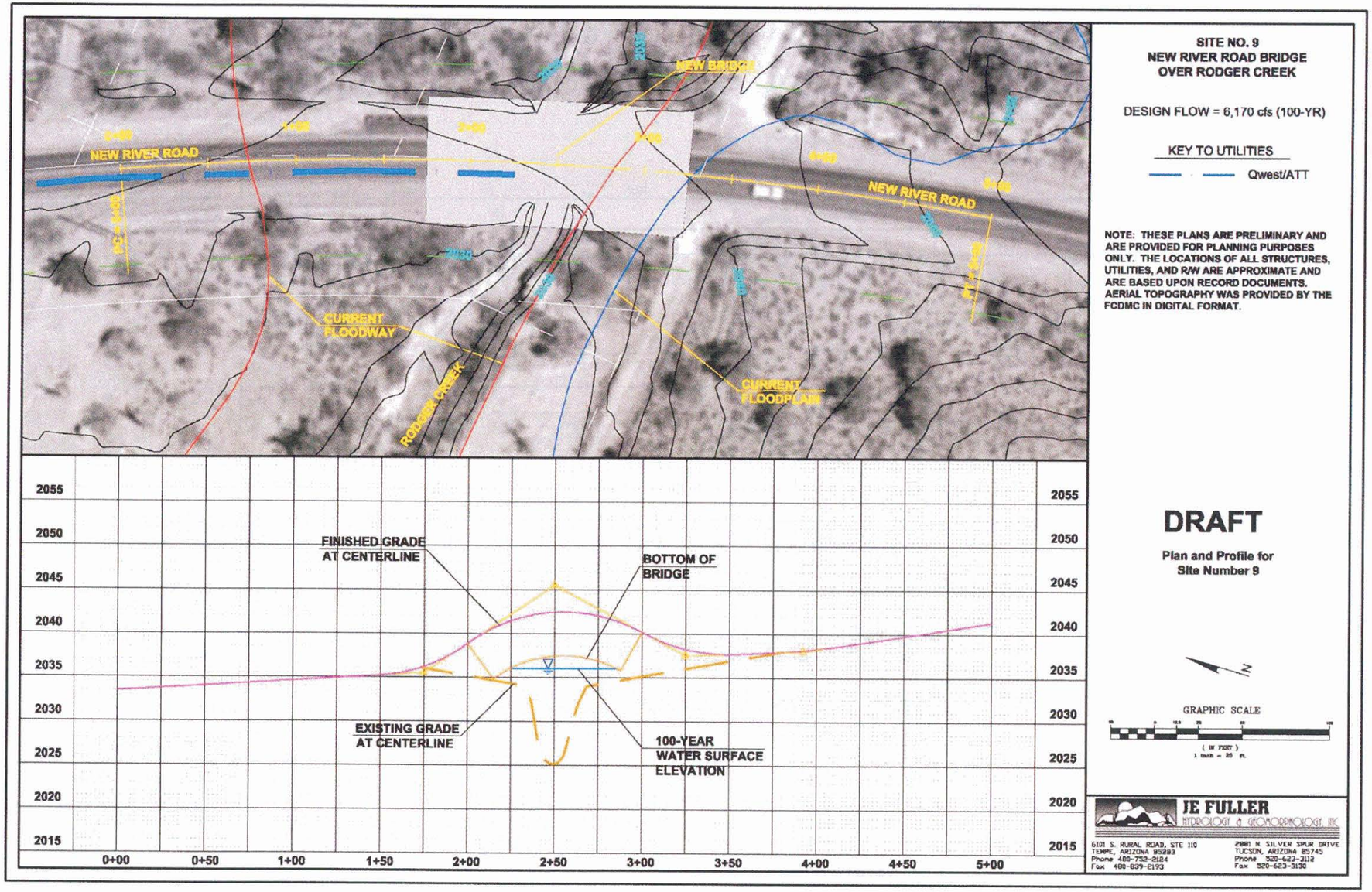
NOTE: THESE PLANS ARE PRELIMINARY AND ARE PROVIDED FOR PLANNING PURPOSES ONLY. THE LOCATIONS OF ALL STRUCTURES, UTILITIES, AND R/W ARE APPROXIMATE AND ARE BASED UPON RECORD DOCUMENTS. AERIAL TOPOGRAPHY WAS PROVIDED BY THE FCDMC IN DIGITAL FORMAT.

DRAFT

Typical Sections for Site Number 8 (Sheet 8B)

C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4730 West Maverick Lane #105
Lakeside, Arizona 85929
Phone 928.368.2246 Fax 928.368.8704

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
5151 S. KIVAL ROAD, STE 110
TEMPE, ARIZONA 85283
PHONE 480-752-2124
FAX 480-838-2193
2561 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
PHONE 520-623-3112
FAX 520-623-3138



SITE NO. 9
NEW RIVER ROAD BRIDGE
OVER RODGER CREEK

DESIGN FLOW = 6,170 cfs (100-YR)

KEY TO UTILITIES

Qwest/ATT

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Plan and Profile for Site Number 9

N

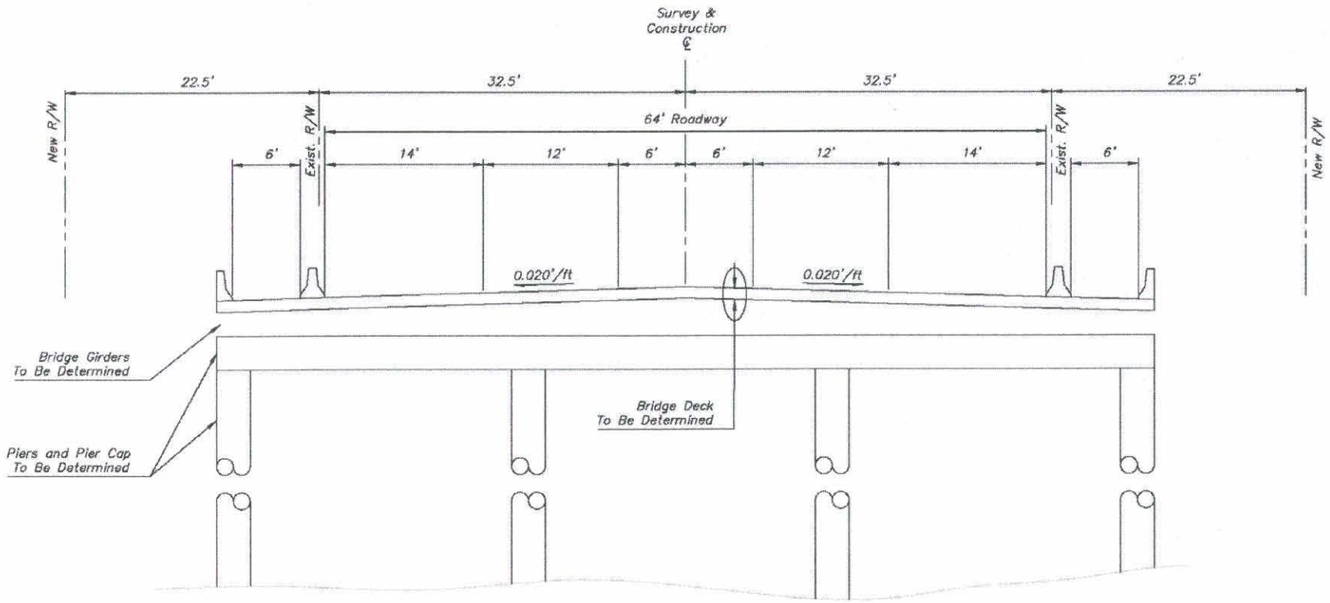
GRAPHIC SCALE

(IN FEET)
1 inch = 25 ft.

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193

2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3136



TYPICAL SECTION FOR BRIDGE
Rural Collector Road (at Section Line)

NOTE: PER DISCUSSIONS WITH MCDOT STAFF

SITE NO. 9
NEW RIVER ROAD BRIDGE
OVER RODGER CREEK

TYPICAL SECTIONS

NOTE: THESE PLANS ARE PRELIMINARY AND ARE PROVIDED FOR PLANNING PURPOSES ONLY. THE LOCATIONS OF ALL STRUCTURES, UTILITIES, AND R/W ARE APPROXIMATE AND ARE BASED UPON RECORD DOCUMENTS. AERIAL TOPOGRAPHY WAS PROVIDED BY THE FCDMC IN DIGITAL FORMAT.

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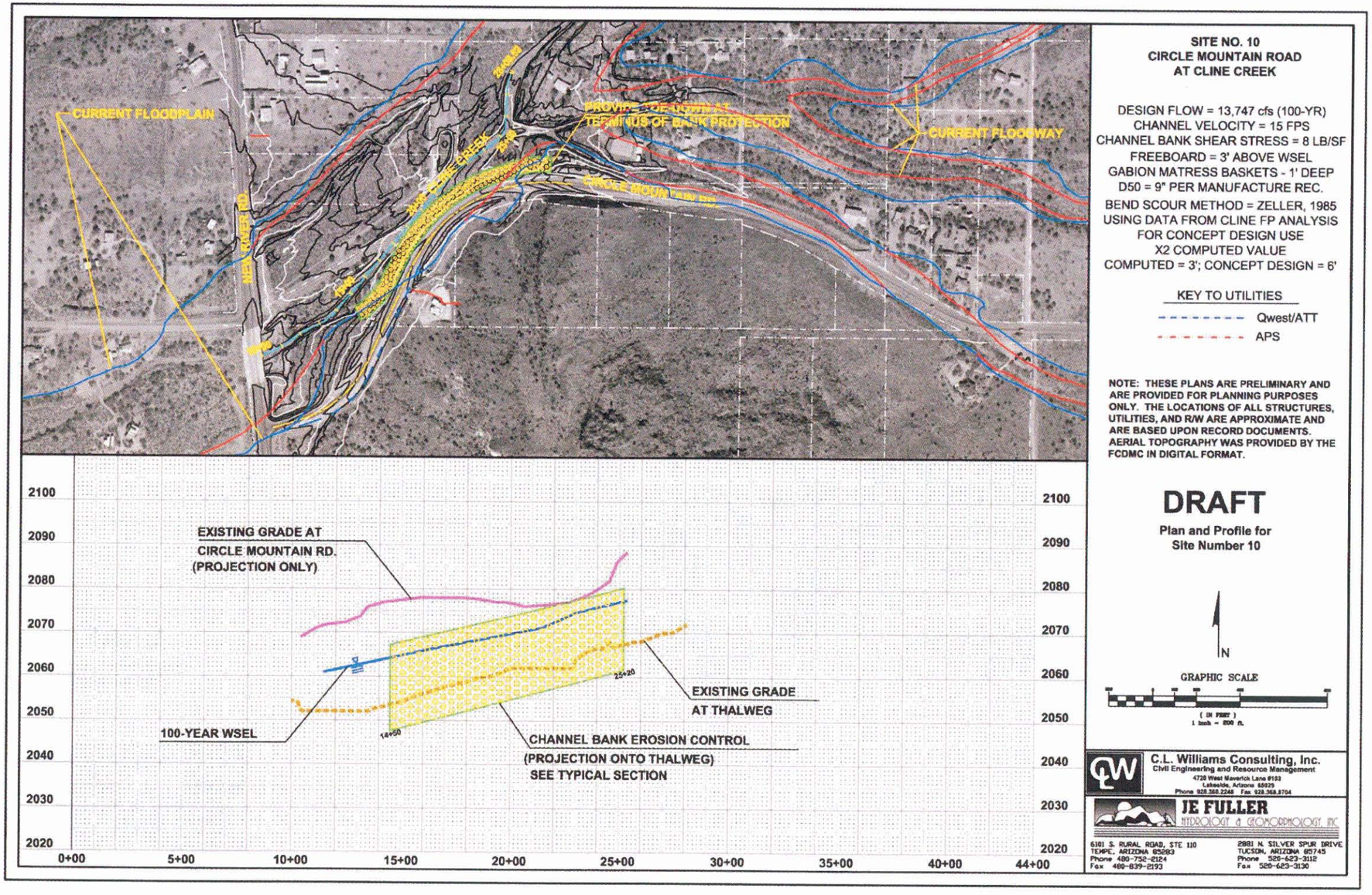
Typical Sections for Site Number 9

C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4728 West Maverick Lane 9183
Lakeside, Arizona 85929
Phone 928.368.2246 Fax 928.368.8704

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
5151 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
PHONE 480-782-2124
FAX 480-838-2193

2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
PHONE 520-623-3112
FAX 520-623-3138



SITE NO. 10
CIRCLE MOUNTAIN ROAD
AT CLINE CREEK

DESIGN FLOW = 13,747 cfs (100-YR)
CHANNEL VELOCITY = 15 FPS
CHANNEL BANK SHEAR STRESS = 8 LB/SF
FREEBOARD = 3' ABOVE WSEL
GABION MATRESS BASKETS - 1' DEEP
D50 = 9" PER MANUFACTURE REC.
BEND SCOUR METHOD = ZELLER, 1985
USING DATA FROM CLINE FP ANALYSIS
FOR CONCEPT DESIGN USE
X2 COMPUTED VALUE
COMPUTED = 3'; CONCEPT DESIGN = 6'

KEY TO UTILITIES
Qwest/ATT
APS

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DRAFT

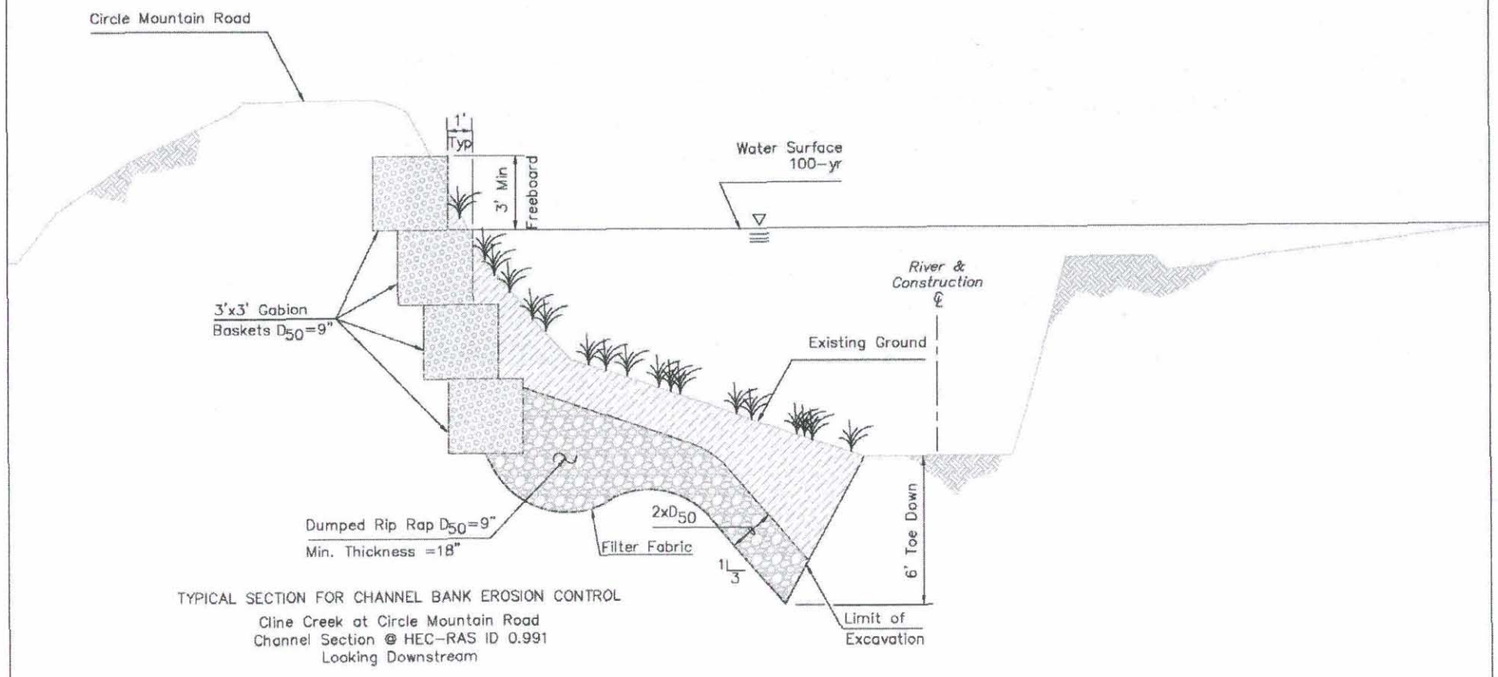
Plan and Profile for
Site Number 10

N

GRAPHIC SCALE
(IN FEET)
1 inch = 200 ft.

C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4720 West Maverick Lane #103
Lakeside, Arizona 85929
Phone 928.368.2246 Fax 928.368.8704

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193
2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130



TYPICAL SECTION FOR CHANNEL BANK EROSION CONTROL
Cline Creek at Circle Mountain Road
Channel Section @ HEC-RAS ID 0.991
Looking Downstream

SITE NO. 10
CIRCLE MOUNTAIN ROAD AT CLINE CREEK

TYPICAL SECTIONS

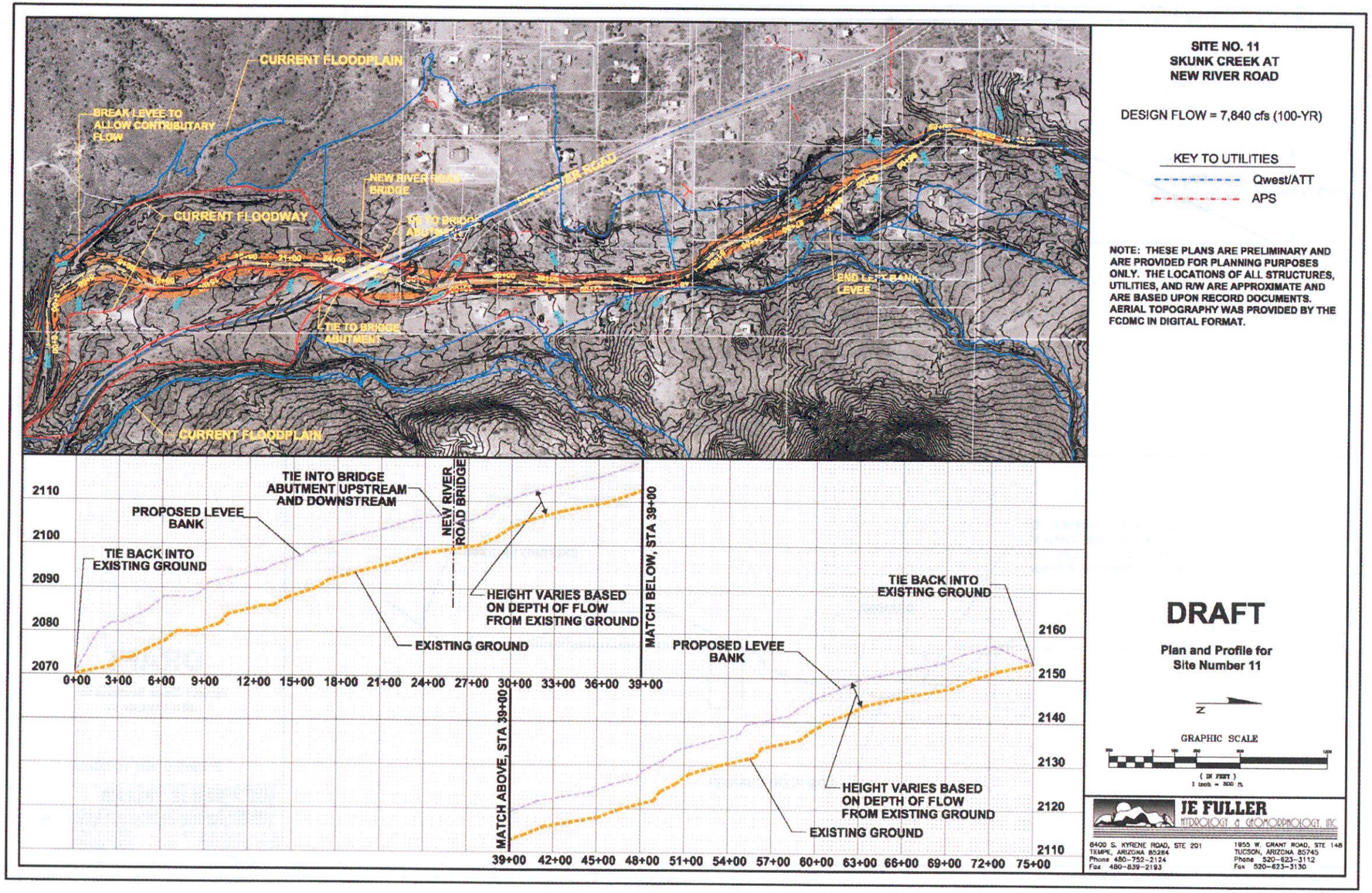
NOTE: THESE PLANS ARE PRELIMINARY AND ARE PROVIDED FOR PLANNING PURPOSES ONLY. THE LOCATIONS OF ALL STRUCTURES, UTILITIES, AND R/W ARE APPROXIMATE AND ARE BASED UPON RECORD DOCUMENTS. AERIAL TOPOGRAPHY WAS PROVIDED BY THE FCDMC IN DIGITAL FORMAT.

DRAFT

Typical Cross Section for Site Number 10

C.L. Williams Consulting, Inc.
Civil Engineering and Resource Management
4720 West Maverick Lane #103
Lakeside, Arizona 85929
Phone 928.368.2248 Fax 928.368.8704

JE FULLER HYDROLOGY & GEOMORPHOLOGY, INC.
8101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
PHONE 480-752-2124
FAX 480-838-2183
3991 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
PHONE 520-623-7112
FAX 520-623-3130



SITE NO. 11
SKUNK CREEK AT
NEW RIVER ROAD

DESIGN FLOW = 7,840 cfs (100-YR)

KEY TO UTILITIES
Qwest/ATT
APS

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DRAFT

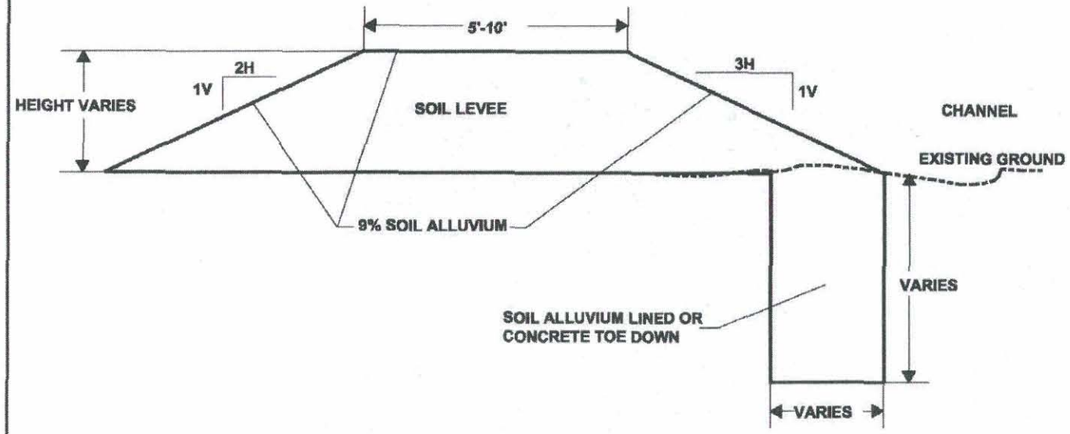
Plan and Profile for Site Number 11

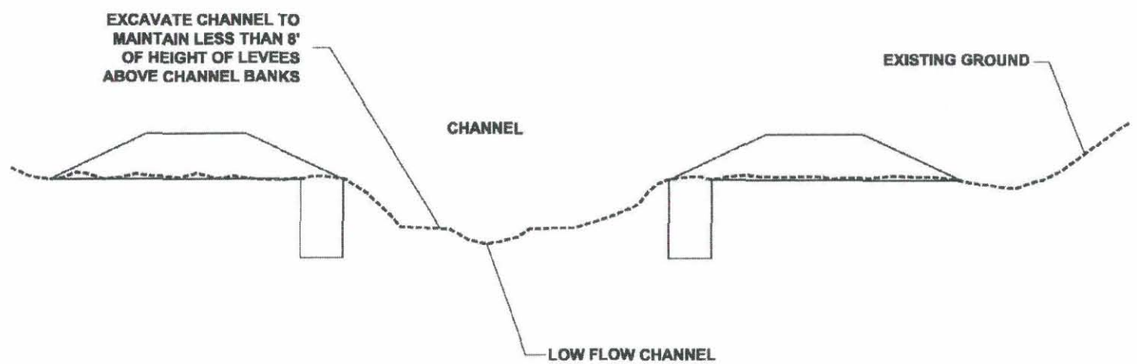
N

GRAPHIC SCALE

(IN FEET)
1 inch = 300 ft.

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
8400 S. KYRENE ROAD, STE 201
TEMPE, ARIZONA 85284
Phone 480-752-2124
Fax 480-839-2193
1955 W. GRANT ROAD, STE 148
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130





SITE NO. 11
SKUNK CREEK AT NEW RIVER ROAD

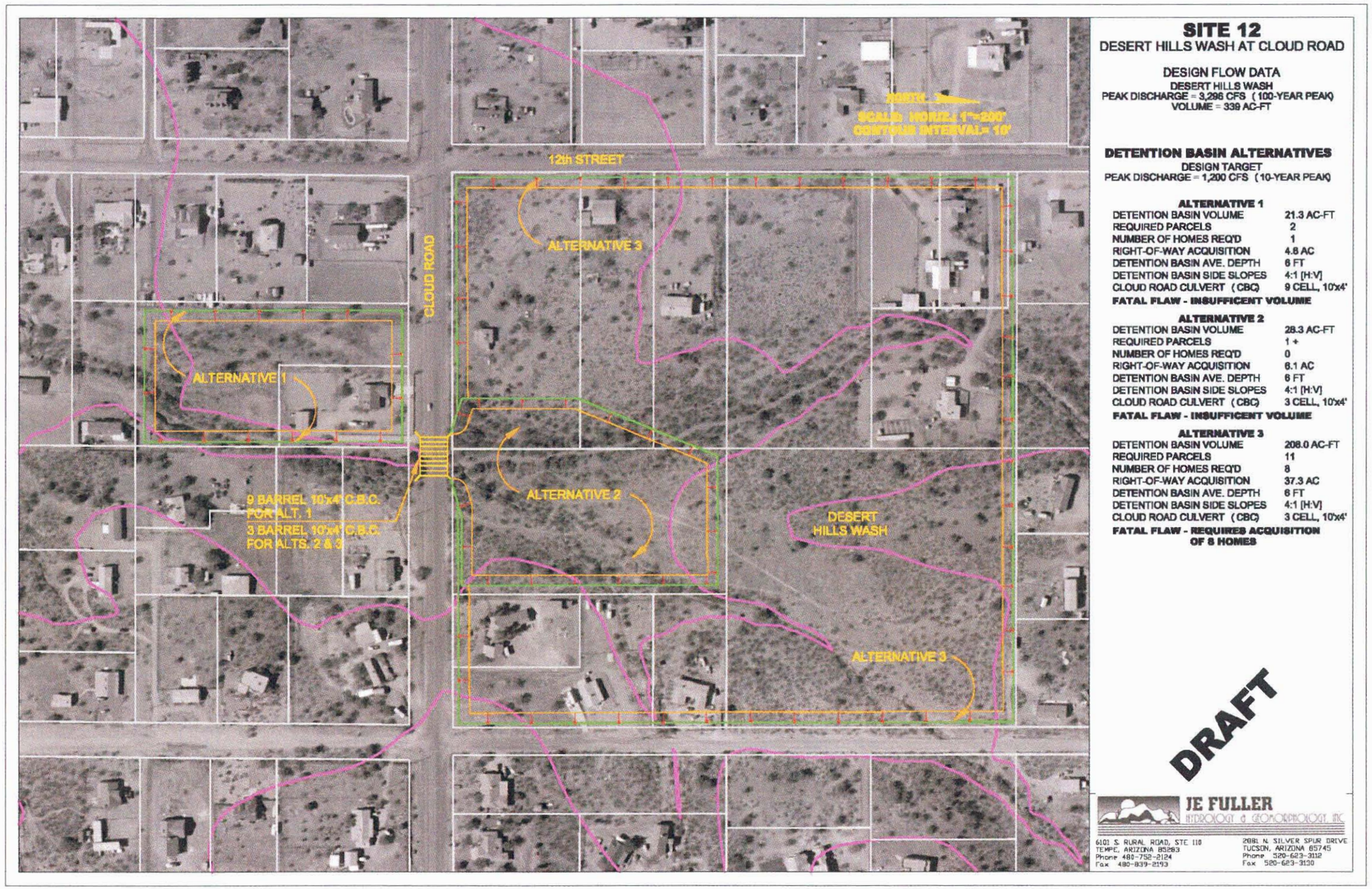
NOTE: THESE PLANS ARE PRELIMINARY AND ARE PROVIDED FOR PLANNING PURPOSES ONLY. THE LOCATIONS OF ALL STRUCTURES, UTILITIES, AND R/W ARE APPROXIMATE AND ARE BASED UPON RECORD DOCUMENTS. AERIAL TOPOGRAPHY WAS PROVIDED BY THE FCDMC IN DIGITAL FORMAT.

DRAFT

Typical Cross Sections for Site Number 11

DRAWING NOT TO SCALE

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
8400 S. KYRENE ROAD, STE. 201
TEMPE, ARIZONA 85284
Phone 480-752-2124
Fax 480-838-2193
1955 W. GRANT ROAD, STE 148
TUCSON, ARIZONA 85745
Phone 520-623-3112
Fax 520-623-3130


12th STREET
CLOUD ROAD
ALTERNATIVE 1
ALTERNATIVE 2
ALTERNATIVE 3
9 BARREL 10'x4' C.B.C.
FOR ALT. 1
3 BARREL 10'x4' C.B.C.
FOR ALTS. 2 & 3
DESERT
HILLS WASH
SCALE: HORIZ. 1"=200'
CONTOUR INTERVAL= 10'
SITE 12
DESERT HILLS WASH AT CLOUD ROAD
DESIGN FLOW DATA
DESERT HILLS WASH
PEAK DISCHARGE = 3,296 CFS (100-YEAR PEAK)
VOLUME = 339 AC-FT
DETENTION BASIN ALTERNATIVES
DESIGN TARGET
PEAK DISCHARGE = 1,200 CFS (10-YEAR PEAK)
ALTERNATIVE 1
DETENTION BASIN VOLUME 21.3 AC-FT
REQUIRED PARCELS 2
NUMBER OF HOMES REQ'D 1
RIGHT-OF-WAY ACQUISITION 4.8 AC
DETENTION BASIN AVE. DEPTH 6 FT
DETENTION BASIN SIDE SLOPES 4:1 [H:V]
CLOUD ROAD CULVERT (CBC) 9 CELL, 10'x4'
FATAL FLAW - INSUFFICENT VOLUME
ALTERNATIVE 2
DETENTION BASIN VOLUME 28.3 AC-FT
REQUIRED PARCELS 1 +
NUMBER OF HOMES REQ'D 0
RIGHT-OF-WAY ACQUISITION 6.1 AC
DETENTION BASIN AVE. DEPTH 6 FT
DETENTION BASIN SIDE SLOPES 4:1 [H:V]
CLOUD ROAD CULVERT (CBC) 3 CELL, 10'x4'
FATAL FLAW - INSUFFICENT VOLUME
ALTERNATIVE 3
DETENTION BASIN VOLUME 208.0 AC-FT
REQUIRED PARCELS 11
NUMBER OF HOMES REQ'D 8
RIGHT-OF-WAY ACQUISITION 37.3 AC
DETENTION BASIN AVE. DEPTH 6 FT
DETENTION BASIN SIDE SLOPES 4:1 [H:V]
CLOUD ROAD CULVERT (CBC) 3 CELL, 10'x4'
FATAL FLAW - REQUIRES ACQUISITION OF 8 HOMES
DRAFT
JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
6101 S. RURAL ROAD, STE 110
TEMPE, ARIZONA 85283
Phone 480-752-2124
Fax 480-839-2193
2881 N. SILVER SPUR DRIVE
TUCSON, ARIZONA 85745
Phone 520-623-3132
Fax 520-623-3130

APPENDIX B

Cost Estimates

Cost Estimates for Site Number 1

Item	Unit	Quantity	Unit Cost	Total
Subgrade Prep.	Sq. Yd.	43413.00	$3.50	$151,945.50
Pavement (surface)	Tons	3662.97	$40.00	$146,518.88
Pavement (base)	Tons	14651.89	$38.00	$556,771.73
Tack Coat	Tons	36.47	$380.00	$13,857.43
Vert. Curb & Gutter	Lin. Ft.	11000.00	$9.00	$99,000.00
Single Curb	Lin. Ft.		$11.00	$0.00
Sidewalk	Sq. Ft.	55000.00	$2.00	$110,000.00
Ribbon Curb	Lin. Ft.		$8.00	$0.00
Landscaping	Sq. Ft.	105000.00	$2.50	$262,500.00
Deco Pavement	Sq. Ft.	1000.00	$6.00	$6,000.00
Street Lights	Lin. Ft.	11000.00	$8.00	$88,000.00
Storm Drain	Lin. Ft.	5280.00	$200.00	$1,056,000.00
Catch Basins	Each	20.00	$2,500.00	$50,000.00
Bridge	Sq. Ft.	37600.00	$66.00	$2,481,600.00
Channelization	C.Y.	385000.00	$3.00	$1,155,000.00
Soil Cement Bank Protection	C.Y.	71000.00	$50.00	$3,550,000.00
Remove RCC Drop Structure	L.S.	1.00	$200,000.00	$200,000.00
New RCC Drop Structure	C.Y.	6000.00	$75.00	$450,000.00
Adjustments	Each	40.00	$300.00	$12,000.00
Remove V.C.&G.	Lin. Ft.		$1.00	$0.00
Remove Concrete D/W,S/W,etc.	Sq. Ft.		$1.50	$0.00
Remove Structures	L.S.			$0.00
Misc.Removal and Other Work	L.S.	1.00	$15,000.00	$15,000.00
Waterline Relocation	Each			$0.00
Traffic Signals (Per Intersection)	Each	1.00	$50,000.00	$50,000.00
Contingent (20%)	L.S.			$2,090,838.71
TOTAL				**$12,545,032.24**

Cost Estimates for Site Number 1

Item	Unit	Quantity	Unit Cost	Total
Design Cost				
Consultant				$752,701.93
DCM Staff				$1,003,602.58
Construction Adm.				$1,756,304.51
TOTAL Design/Const.				**$3,512,609.03**
Right-of-Way				$250,000.00
GRAND TOTAL				**$16,307,641.26**

Note: Costs provided by the City of Phoenix. This job has already been sent out for design bid.

No edits were made to the cost estimates at this time.

Cost Estimates for Site Number 2

COSTS WITH CONCRETE TOE-DOWN

Item	Construction				Land				Contingency	Engineering	Total
	Units	Unit Cost	Quantity	Construction Cost	Units	Unit Cost	Quantity	Land Cost			
Dike Embankment	Cu. Yd.	$ 7	112217	$ 785,519	SF	$ 1.50	832373	$ 1,248,560	$ 196,380	$ 117,828	$ 2,348,286
Soil-Cement Bank Protection	Cu. Yd.	$ 71	10688	$ 758,848	SF	$ 1.50	0	$ -	$ 189,712	$ 113,827	$ 1,062,387
Clearing and Grubbing	LS	$ 4,000	1	$ 4,000	SF	$ 1.50	0	$ -	$ 1,000	$ 600	$ 5,600
Concrete Toe-Down (for Soil Cement Lining)	Cu. Yd.	$ 155	12332	$ 1,911,460	SF	$ 1.50	0	$ -	$ 477,865	$ 286,719	$ 2,676,044
			Totals	$ 3,459,827				$ 1,248,560	$ 864,957	$ 518,974	**$ 6,092,317**

Note: Land costs are assumed to equal $1.50 per square foot raw ground and is only the footprint of the structural alternative. This is equal to $65,340.26 per acre. (July, 2004)

COST WITH CEMENT SOIL ALLUVIUM TOE-DOWN

Item	Construction				Land				Contingency	Engineering	Total
	Units	Unit Cost	Quantity	Construction Cost	Units	Unit Cost	Quantity	Land Cost			
Dike Embankment	Cu. Yd.	$ 7	112217	$ 785,519	SF	$ 1.50	832373	$ 1,248,560	$ 196,380	$ 117,828	$ 2,348,286
Soil-Cement Bank Protection	Cu. Yd.	$ 71	66180	$ 4,698,780	SF	$ 1.50	0	$ -	$ 1,174,695	$ 704,817	$ 6,578,292
Clearing and Grubbing	LS	$ 4,000	1	$ 4,000	SF	$ 1.50	0	$ -	$ 1,000	$ 600	$ 5,600
			Totals	$ 5,488,299				$ 1,248,560	$ 1,372,075	$ 823,245	**$ 8,932,178**

Note: Land costs are assumed to equal $1.50 per square foot raw ground and is only the footprint of the structural alternative. This is equal to $65,340.26 per acre. (July, 2004)

LAND COSTS ASSUMING FULL TAKE ON AFFECTED PROPERTIES

Number of Parcels	Land				Number of Dev. Parcels	Unit Cost	Developed Costs	Total
	Units	Unit Cost	Quantity	Land Cost				
12 - Undeveloped Parcels	SF	$ 1.50	12938481	$ 19,407,722	0	$ -	$ -	$ 19,407,722
1 - Developed Parcel	SF	$ 1.50	0	$ -	1	$ 185,000	$ 185,000	$ 185,000
	Totals			$ 19,407,722			$ 185,000	**$ 19,592,722**

SUMMARY

	Minimum Costs	Maximum Costs
Range of Costs	**$ 6,092,317**	**$ 27,276,341**

Number of Parcels negatively impacted	**13**
Number of Parcels positively impacted	**25**

Note: All parcel and structure data based on 2002 parcel and aerial data.

Cost Estimates for Site Number 3

DESIGN CRITERIA

60 mph Design Speed, Rural Major Collector, 4% MSE – R = 1,600 ft, MCDOT 1993/AASHTO 2001 Standards, 300' Minimum Vertical Curves, and a potential fatal flaw of not meeting the design criteria and potential profile conflicts that may exist at Cloud Road.

ACTUAL RESULTS

40 mph Design Speed
Minimum Radius = 400 ft

ESTIMATE OF COSTS

Item	Construction				Land				Contigency	Engineering	Total
	Units	Unit Cost	Quantity	Construction Cost	Units	Unit Cost	Quantity	Land Cost			
Roadway Fill	Cu. Yd.	$ 10	13850	$ 138,500	SF	$ 1.50	0	$ -	$ 34,625	$ 20,775	$ 193,900
Pavement	Sq. Yd.	$ 25	9900	$ 247,500	SF	$ 1.50	0	$ -	$ 61,875	$ 37,125	$ 346,500
Misc. Roadway Items	LS	$ 250,000	1	$ 250,000	SF	$ 1.50	0	$ -	$ 62,500	$ 37,500	$ 350,000
Right-of-Way Acquisition	Acres	$ 50,000	4.7	$ 235,000	SF	$ 1.50	204733	$ 307,100	$ 58,750	$ 35,250	$ 636,100
Demolition	Sq. Yd.	$ 6	8100	$ 48,600	SF	$ 1.50	0	$ -	$ 12,150	$ 7,290	$ 68,040
Rehabilitation	Acres	$ 2,900	4.2	$ 12,180	SF	$ 150.00	0	$ -	$ 3,045	$ 1,827	$ 17,052
Environmental Assessment	LS	$ 100,000	1	$ 100,000	SF	$ 1.50	0	$ -	$ 25,000	$ 15,000	$ 140,000
Right-of-Way Abandonment	LS	$ 20,000	1	$ 20,000	SF	$ 1.50	0	$ -	$ 5,000	$ 3,000	$ 28,000
			Totals	$ 1,051,780				$ 307,100	$ 262,945	$ 157,767	**$ 1,779,592**

Note: Land costs are assumed to equal $1.50 per square foot raw ground and is only the footprint of the structural alternative. This is equal to $65,340.26 per acre. (July, 2004)

Land Costs Assuming Full Take on Affected Properties

Number of Parcels	Land				Number of Dev. Parcels		Developed Costs	Total
	Units	Unit Cost	Quantity	Land Cost		Unit Cost		
3 - Undeveloped Parcels	SF	$ 1.50	1114540	$ 1,671,810	0	$ -	$ -	$ 1,671,810
2 - Developed Parcel	SF	$ 1.50	197032	$ 295,548	3	$ 185,000	$ 555,000	$ 850,548
Totals				$ 1,967,358			$ 555,000	**$ 2,522,358**

Summary

	Minimum Costs	Maximum Costs
Range of Costs	**$ 1,779,592**	**$ 3,994,850**

Number of Parcels negatively impacted	**5**
Number of Parcels positively impacted	**56** (Approximately)

Note: All parcel and structure data based on 2002 parcel and aerial data.

Cost Estimates for Site Number 4

Item	Description	Cost Estimates										
		Construction				Land				Contingency	Engineering	Total
		Units	Unit Cost	Quantity	Construction Cost	Units	Unit Cost	Quantity	Land Cost			
CLV4A	2 barrels of 60-inch concrete pipe with inlet and outlet headwalls.	LF	$140	100	$ 14,000	SF	$1.50	2000	$ 3,000	$ 3,500	$ 2,100	$ 22,600
CLV4B	2 barrels of 60-inch concrete pipe with inlet and outlet headwalls.	LF	$140	100	$ 14,000	SF	$1.50	2000	$ 3,000	$ 3,500	$ 2,100	$ 22,600
CLV4C	2 barrels of 60-inch concrete pipe with inlet and outlet headwalls.	LF	$140	100	$ 14,000	SF	$1.50	2000	$ 3,000	$ 3,500	$ 2,100	$ 22,600
CLV4D	2 barrels of 60-inch concrete pipe with inlet and outlet headwalls.	LF	$140	100	$ 14,000	SF	$1.50	2000	$ 3,000	$ 3,500	$ 2,100	$ 22,600
CH4A	1600' of 30' Channel	LF	$50	1600	$ 80,000	SF	$1.50	32000	$ 48,000	$ 20,000	$ 12,000	$160,000
CH4B	4800' of 56' Channel	LF	$135	4800	$ 648,000	SF	$1.50	192000	$ 288,000	$ 162,000	$ 97,200	$1,195,200
CLV4E	4 barrels of 12'x5' RCBC with inlet and outlet headwalls.	LF	$600	600	$ 360,000	SF	$1.50	28800	$ 43,200	$ 90,000	$ 54,000	$ 547,200
BASIN 4A	60 Ac-Ft Offline Detention Basin	LS	$484,000	1	$ 484,000	SF	$1.50	261361	$ 392,042	$ 121,000	$ 72,600	$1,069,642
CH4C	1600' of 44' Channel	LF	$135	1600	$ 216,000	SF	$1.50	80000	$ 120,000	$ 54,000	$ 32,400	$ 422,400
CLV4F	2 barrels of 8'x5' RCBC with inlet and outlet headwalls.	LF	$490	160	$ 78,400	SF	$1.50	5120	$ 7,680	$ 19,600	$ 11,760	$ 117,440
CH4D	1600' of 48' Channel	LF	$135	1600	$ 216,000	SF	$1.50	80000	$ 120,000	$ 54,000	$ 32,400	$ 422,400
CLV4G	3 barrels of 8'x5' RCBC with inlet and outlet headwalls.	LF	$500	240	$ 120,000	SF	$1.50	7680	$ 11,520	$ 30,000	$ 18,000	$ 179,520
CH4E	800' of 56' Channel	LF	$135	800	$ 108,000	SF	$1.50	48000	$ 72,000	$ 27,000	$ 16,200	$ 223,200
BASIN 4B	65 Ac-Ft Offline Detention Basin	LS	$565,000	1	$ 565,000	SF	$1.50	188761	$ 283,142	$ 141,250	$ 84,750	$1,074,142
BASIN 4C	71 Ac-Ft Online Detention Basin	LS	$573,000	1	$ 573,000	SF	$1.50	309278	$ 463,917	$ 143,250	$ 85,950	$1,266,117
CLV4H	4 barrels of 12'x5' RCBC with inlet and outlet headwalls.	LF	$600	400	$ 240,000	SF	$1.50	19200	$ 28,800	$ 60,000	$ 36,000	$ 364,800
CH4F	900' of 56' Channel	LF	$135	900	$ 121,500	SF	$1.50	54000	$ 81,000	$ 30,375	$ 18,225	$ 251,100
CH4G	2400' of 70' Channel	LF	$140	2400	$ 336,000	SF	$1.50	168000	$ 252,000	$ 84,000	$ 50,400	$ 722,400
CLV4I	Ford Crossing	LS	$10,000	1	$ 10,000	SF	$1.50	9600	$ 14,400	$ 2,500	$ 1,500	$ 28,400
CLV4J	Ford Crossing	LS	$10,000	1	$ 10,000	SF	$1.50	9600	$ 14,400	$ 2,500	$ 1,500	$ 28,400
				Totals	$ 4,221,900				$2,252,100	$ 1,055,475	$ 633,285	**$8,162,760**

Note: Land costs are assumed to equal $1.50 per square foot raw ground and is only the footprint of the structural alternative. This is equal to $65,340.26 per acre. (July, 2004)

Land Costs Assuming Full Take on Affected Properties

Number of Parcels		Land				Number of Dev. Parcels	Developed		
		Units	Unit Cost	Quantity	Land Cost		Unit Cost	Costs	Total
14 - Undeveloped Parcels		SF	$ 1.50	2607718	$3,911,577	0	$ -	$ -	$ 3,911,577
18 - Developed Parcel		SF	$ 1.50	1987584	$2,981,376	18	$ 185,000	$ 3,330,000	$ 6,311,376
	Totals				$6,892,953			$ 3,330,000	**$10,222,953**

Cost Estimates for Site Number 4

Summary

	Minimum Costs	Maximum Costs
Range of Costs	$ 8,162,760	$ 16,133,613

Number of Parcels negatively impacted	**32**
Number of Parcels positively impacted	**48** (Approximately)

Note: All parcel and structure data based on 2002 parcel and aerial data.

Cost Estimates for Site Number 5

COST ESTIMATES

Item	Description	Construction				Land				Contingency	Engineering	Total
		Units	Unit Cost	Quantity	Construction Cost	Units	Unit Cost	Quantity	Land Cost			
CH5A	3200' of 48' Channel	LF	$135	3200	$ 432,000	SF	$1.50	160000	$ 240,000	$ 108,000	$ 64,800	$ 844,800
CLV5A	3 barrels of 12'x5' RCBC with inlet and outlet headwalls.	LF	$600	240	$ 144,000	SF	$1.50	11520	$ 17,280	$ 36,000	$ 21,600	$ 218,880
CLV5B	3 barrels of 12'x5' RCBC with inlet and outlet headwalls.	LF	$600	240	$ 144,000	SF	$1.50	11520	$ 17,280	$ 36,000	$ 21,600	$ 218,880
CH5B	2400' of 44" Channel	LF	$75	2400	$ 180,000	SF	$1.50	2000	$ 3,000	$ 45,000	$ 27,000	$ 255,000
BASIN 5A	40 Ac-Ft Offline Detention Basin	LS	$363,000	1	$ 363,000	SF	$1.50	348482	$ 522,723	$ 90,750	$ 54,450	$1,030,923
CH5C	9,800' of 44' Channel	LF	$75	9800	$ 735,000	SF	$1.50	490000	$ 735,000	$ 183,750	$ 110,250	$1,764,000
CLV5C	1- 8'x5' RCBC with inlet and outlet headwalls.	LF	$480	120	$ 57,600	SF	$1.50	3840	$ 5,760	$ 14,400	$ 8,640	$ 86,400
CLV5D	1- 8'x5' RCBC with inlet and outlet headwalls.	LF	$480	120	$ 57,600	SF	$1.50	3840	$ 5,760	$ 14,400	$ 8,640	$ 86,400
CH5D	3400' of 51" Channel	LF	$135	3400	$ 459,000	SF	$1.50	187000	$ 280,500	$ 114,750	$ 68,850	$ 923,100
CLV5E	4 barrels of 12'x5' RCBC with inlet and outlet headwalls.	LF	$600	600	$ 360,000	SF	$1.50	28800	$ 43,200	$ 90,000	$ 54,000	$ 547,200
CLV5F	4 barrels of 12'x5' RCBC with inlet and outlet headwalls.	LF	$600	600	$ 360,000	SF	$1.50	28800	$ 43,200	$ 90,000	$ 54,000	$ 547,200
				Totals	$ 3,292,200				$1,913,703	$ 823,050	$ 493,830	**$6,522,783**

Note: Land costs are assumed to equal $1.50 per square foot raw ground and is only the footprint of the structural alternative. This is equal to $65,340.26 per acre. (July, 2004)

LAND COSTS ASSUMING FULL TAKE ON AFFECTED PROPERTIES

Number of Parcels	Land				Number of Dev. Parcels	Developed		
	Units	Unit Cost	Quantity	Land Cost		Unit Cost	Costs	Total
16 - Undeveloped Parcels	SF	$ 1.50	2663190	$ 3,994,785	0	$ -	$ -	$ 3,994,785
12 - Developed Parcel	SF	$ 1.50	1146140	$ 1,719,211	12	$ 185,000	$ 2,220,000	$ 3,939,211
Totals				$ 5,713,995			$ 2,220,000	**$ 7,933,995**

SUMMARY

	Minimum Costs	Maximum Costs
Range of Costs	**$ 6,522,783**	**$ 12,543,075**

Number of Parcels negatively impacted	**29**
Number of Parcels positively impacted	**47** (Approximately)

Note: All parcel and structure data based on 2002 parcel and aerial data.

Cost Estimates for Site Number 6

Description	Construction				Contingency	Engineering	Total
	Units	Unit Cost	Quantity	Construction Cost			
Channel Excavation	Cu.Yd.	$6	27250	$ 163,500	$ 40,875	$ 24,525	$ 228,900
Rip Rap	Cu.Yd.	$65	15000	$ 975,000	$ 243,750	$ 146,250	$ 1,365,000
Guardrail	LF	$20	6300	$ 126,000	$ 31,500	$ 18,900	$ 176,400
Misc. Roadway Items	LS	$210,000	5	$ 1,050,000	$ 262,500	$ 157,500	$ 1,470,000
Right-of-Way Acquisition	Acre	$50,000	2.6	$ 130,000	$ 32,500	$ 19,500	$ 182,000
Concrete Box Culvert (10'x4')	LF	$550	1963	$ 1,079,650	$ 269,913	$ 161,948	$ 1,511,510
Relocations & Adjustments	LS	$120,000	5	$ 600,000	$ 150,000	$ 90,000	$ 840,000
Concrete Box Culvert (10'x5')	LF	$766	2,380	$ 1,823,080	$ 455,770	$ 273,462	$ 2,552,312
New Bridge	Sq. Ft.	$85	21420	$ 1,820,700	$ 455,175	$ 273,105	$ 2,548,980
Concrete Box Culvert (8'x8')	LF	$600	375	$ 225,000	$ 56,250	$ 33,750	$ 315,000
			Totals	$ 7,992,930	$ 1,998,233	$ 1,198,940	**$ 11,190,102**

SUMMARY

	Minimum Costs		Maximum Costs	
Range of Costs	**$ 11,190,102**		**$ 11,190,102**	

Number of Parcels negatively impacted	**8**
Number of Parcels positively impacted	**31** (Approximately)

Note: All parcel and structure data based on 2002 parcel and aerial data.

Cost Estimates for Site Number 7

Description	Construction				Contingency	Engineering	Total
	Units	Unit Cost	Quantity	Construction Cost			
Roadway Excavation	Cu.Yd.	$10	3,000	$ 30,000	$ 7,500	$ 4,500	$ 42,000
Pavement	Sq. Yd.	$25	22,000	$ 550,000	$ 137,500	$ 82,500	$ 770,000
Misc. Roadway Items	LS	$250,000	1	$ 250,000	$ 62,500	$ 37,500	$ 350,000
Right-of-Way Acquisition	Acre	$50,000	13.6	$ 680,000	$ 170,000	$ 102,000	$ 952,000
Improvements (Carefree Highway)	LS	$65,000	1	$ 65,000	$ 16,250	$ 9,750	$ 91,000
Demolition	Sq. Yd.	$5	22,100	$ 110,500	$ 27,625	$ 16,575	$ 154,700
Rehabilitation	Acre	$2,845	8.8	$ 25,036	$ 6,259	$ 3,755	$ 35,050
Environmental Assessment	LS	$100,000	1	$ 100,000	$ 25,000	$ 15,000	$ 140,000
Right-of-Way Abandonment	LS	$20,000	1	$ 20,000	$ 5,000	$ 3,000	$ 28,000
			Totals	$ 1,830,536	$ 457,634	$ 274,580	**$ 2,562,750**

SUMMARY

	Minimum Costs		Maximum Costs	
Range of Costs	**$ 2,562,750**		**$ 2,562,750**	

Number of Parcels negatively impacted	**2**
Number of Parcels positively impacted	**50** (Approximately)

Note: All parcel and structure data based on 2002 parcel and aerial data.

Cost Estimates for Site Number 8

COST ESTIMATE

Description	Construction				Contingency	Engineering	Total
	Units	Unit Cost	Quantity	Construction Cost			
Roadway Excavation	Cu.Yd.	$10	1,800	$ 18,000	$ 4,500	$ 2,700	$ 25,200
Pavement	Sq. Yd.	$25	12,550	$ 313,750	$ 78,438	$ 47,063	$ 439,250
Misc. Roadway Items	LS	$250,000	1	$ 250,000	$ 62,500	$ 37,500	$ 350,000
Right-of-Way Acquisition	Acre	$50,000	6.2	$ 310,000	$ 77,500	$ 46,500	$ 434,000
Bridge	Sq. Ft.	$85	121,200	$ 10,302,000	$ 2,575,500	$ 1,545,300	$ 14,422,800
Guardrail	LF	$15	200	$ 3,000	$ 750	$ 450	$ 4,200
Guardrail Terminals	Each	$2,500	4.0	$ 10,000	$ 2,500	$ 1,500	$ 14,000
			Totals	$ 11,206,750	$ 2,801,688	$ 1,681,013	**$ 15,689,450**

SUMMARY

	Minimum Costs		Maximum Costs	
Range of Costs	**$ 15,689,450**		**$ 15,689,450**	

Number of Parcels negatively impacted	**12**
Number of Parcels positively impacted	**65** (Approximately)

Note: All parcel and structure data based on 2002 parcel and aerial data.

Cost Estimates for Site Number 9

COST ESTIMATE

Description	Construction				Land				Contingency	Engineering	Tota
	Units	Unit Cost	Quantity	Construction Cost	Units	Unit Cost	Quantity	Land Cost			
Roadway Excavation	Cu.Yd.	$10	500	$ 5,000	SF	$1.50	0	$ -	$ 1,250	$ 750	$ 7,000
Pavement	Sq. Yd.	$25	1450	$ 36,250	SF	$1.50	0	$ -	$ 9,063	$ 5,438	$ 50,750
Misc. Roadway Items	LS	$250,000	1	$ 250,000	SF	$1.50	0	$ -	$ 62,500	$ 37,500	$ 350,000
Right-of-Way Acquisition	Acre	$50,000	1	$ 50,000	SF	$1.50	43560	$ 65,340	$ 12,500	$ 7,500	$ 135,340
Bridge	Sq. Ft.	$85	10800	$ 918,000	SF	$1.50	0	$ -	$ 229,500	$ 137,700	$ 1,285,200
Guardrail	LF	$15	1200	$ 18,000	SF	$1.50	0	$ -	$ 4,500	$ 2,700	$ 25,200
Guardrail Terminals	Each	$2,500	4	$ 10,000	SF	$1.50	0	$ -	$ 2,500	$ 1,500	$ 14,000
			Totals	$ 1,287,250				$ 65,340	$ 321,813	$ 193,088	**$ 1,867,490**

Note: Land costs are assumed to equal $1.50 per square foot raw ground and is only the footprint of the structural alternative. This is equal to $65,340.26 per acre. (July, 2004)

LAND COSTS ASSUMING FULL TAKE ON AFFECTED PROPERTIES

Number of Parcels	Land				Number of Dev. Parcels	Developed		
	Units	Unit Cost	Quantity	Land Cost		Unit Cost	Costs	Total
1 - Undeveloped Parcels	SF	$ 1.50	95947	$ 143,921	0	$ -	$ -	$ 143,921
1 - Developed Parcel	SF	$ 1.50	206257	$ 309,386	1	$ 185,000	$ 185,000	$ 494,386
Totals				$ 453,306			$ 185,000	**$ 638,306**

SUMMARY

	Minimum Costs		Maximum Costs
Range of Costs	**$ 1,867,490**		**$ 2,440,456**

Number of Parcels negatively impacted	**2**
Number of Parcels positively impacted	**5** (5 Directly, All of the Cline Creek and New River area)

Note: All parcel and structure data based on 2002 parcel and aerial data.

Cost Estimates for Site Number 10

COST ESTIMATE

Description	Construction				Land				Contingency	Engineering	Total
	Units	Unit Cost	Quantity	Construction Cost	Units	Unit Cost	Quantity	Land Cost			
Excavation	Cu.Yd.	$10	25400	$ 254,000	SF	$1.50	83468.55	$ 125,203	$ 63,500	$ 38,100	$ 480,803
Gabions	Cu.Yd.	$85	1560	$ 132,600	SF	$1.50	0	$ -	$ 33,150	$ 19,890	$ 185,640
Dumped Rip Rap	Cu.Yd.	$65	8000	$ 520,000	SF	$1.50	0	$ -	$ 130,000	$ 78,000	$ 728,000
Landscaping	Sq. Yd.	$6	9200	$ 55,200	SF	$1.50	0	$ -	$ 13,800	$ 8,280	$ 77,280
Misc. Erosion Items	LS	$100,000	1	$ 100,000	SF	$1.50	0	$ -	$ 25,000	$ 15,000	$ 140,000
			Totals	$ 1,061,800				$ 125,203	$ 265,450	$ 159,270	**$ 1,611,723**

Note: Land costs are assumed to equal $1.50 per square foot raw ground and is only the footprint of the structural alternative. This is equal to $65,340.26 per acre. (July, 2004)

LAND COSTS ASSUMING FULL TAKE ON AFFECTED PROPERTIES

Number of Parcels	Land				Number of Dev. Parcels	Developed		
	Units	Unit Cost	Quantity	Land Cost		Unit Cost	Costs	Total
2 - Undeveloped Parcels	SF	$ 1.50	776281	$ 1,164,422	0	$ -	$ -	$ 1,164,422
0 - Developed Parcel	SF	$ 1.50	0	$ -	0	$ -	$ -	$ -
Totals				$ 1,164,422			$ -	**$ 1,164,422**

SUMMARY

	Minimum Costs		Maximum Costs
Range of Costs	**$ 1,611,723**		**$ 2,650,942**

Number of Parcels negatively impacted	**2**
Number of Parcels positively impacted	**4 Square Miles** (All of the Cline Creek Area)

Note: All parcel and structure data based on 2002 parcel and aerial data.

Cost Estimates for Site Number 11

COSTS WITH CONCRETE TOE-DOWN

Item	Construction				Land				Contingency	Engineering	Total
	Units	Unit Cost	Quantity	Construction Cost	Units	Unit Cost	Quantity	Land Cost			
Dike Embankment	Cu. Yd.	$ 7	80000	$ 560,000	SF	$ 1.50	885000	$1,327,500	$ 140,000	$ 84,000	$2,111,500
Channel Excavation	Cu. Yd.	$ 10	10000	$ 100,000	SF	$ 1.50	0	$ -	$ 25,000	$ 15,000	$ 140,000
Soil-Cement Bank Protection	Cu. Yd.	$ 71	11750	$ 834,250	SF	$ 1.50	0	$ -	$ 208,563	$ 125,138	$1,167,950
Clearing and Grubbing	LS	$ 8,000	1	$ 8,000	SF	$ 1.50	0	$ -	$ 2,000	$ 1,200	$ 11,200
Concrete Toe-Down (for Soil Cement Lining)	Cu. Yd.	$ 155	6750	$ 1,046,250	SF	$ 1.50	0	$ -	$ 261,563	$ 156,938	$1,464,750
			Totals	$ 2,548,500				$1,327,500	$ 637,125	$ 382,275	**$4,895,400**

Note: Land costs are assumed to equal $1.50 per square foot raw ground and is only the footprint of the structural alternative. This is equal to $65,340.26 per acre. (July, 2004)

COST WITH CEMENT SOIL ALLUVIUM TOE-DOWN

Item	Construction				Land				Contingency	Engineering	Total
	Units	Unit Cost	Quantity	Construction Cost	Units	Unit Cost	Quantity	Land Cost			
Dike Embankment	Cu. Yd.	$ 7	80000	$ 560,000	SF	$ 1.50	885000	$1,327,500	$ 140,000	$ 84,000	$2,111,500
Channel Excavation	Cu. Yd.	$ 10	10000	$ 100,000	SF	$ 1.50	0	$ -	$ 25,000	$ 15,000	$ 140,000
Soil-Cement Bank Protection	Cu. Yd.	$ 71	16500	$ 1,171,500	SF	$ 1.50	0	$ -	$ 292,875	$ 175,725	$1,640,100
Clearing and Grubbing	LS	$ 8,000	1	$ 8,000	SF	$ 1.50	0	$ -	$ 2,000	$ 1,200	$ 11,200
			Totals	$ 1,839,500				$1,327,500	$ 459,875	$ 275,925	**$3,902,800**

Note: Land costs are assumed to equal $1.50 per square foot raw ground and is only the footprint of the structural alternative. This is equal to $65,340.26 per acre. (July, 2004)

LAND COSTS ASSUMING FULL TAKE ON AFFECTED PROPERTIES

Number of Parcels	Land				Number of Dev. Parcels	Developed		
	Units	Unit Cost	Quantity	Land Cost		Unit Cost	Costs	Total
5 - Undeveloped Parcels	SF	$ 1.50	307969	$ 461,954	0	$ -	$ -	$ 461,954
16 - Developed Parcel	SF	$ 1.50	3041562	$ 4,562,343	16	$ 185,000	$ 2,960,000	$ 7,522,343
Totals				$ 5,024,297			$ 2,960,000	**$ 7,984,297**

Summary

	Minimum Costs		Maximum Costs
Range of Costs	**$ 3,902,800**		**$ 11,552,197**
Number of Parcels negatively impacted	**21**		
Number of Parcels positively impacted	**64** (Approximately)		

Note: All parcel and structure data based on 2002 parcel and aerial data.

APPENDIX C

Recommended Alternative Evaluation Comments

Site Number 1	
Structural (+'s)	**Non Structural (+'s)**
• Solves Flooding	
Structural (-'s)	**Non Structural (-'s)**
• Current LOMR Under Review • No Funds From FCDMC in CIP	

Site Number 2	
Structural (+'s)	**Non Structural (+'s)**
• Protection of Freeway • Removes Downstream Floodplain (Mitigates hazard to residences/ business) • Cost Sharing Partners (COP Downstream, ADOT Upstream, maybe CAP) • Agency Acceptance • Multi-Use Path (Planned Regional Facility) • Public Safety • Community Acceptance • Avoid Disturbing Washes	• Development Guidelines Maintain Upstream Flows at Current Conditions • Floodplain Delineation Less Expensive than Structural • Cost Share Downstream with COP • Cost Share Upstream with ADOT
Structural (-'s)	**Non Structural (-'s)**
• Removal of Vegetation Under Levee Footprint • Aesthetics • Acquisition of Business • Expensive	• Floodplain Delineation Only Solves Part of the Problem • Non-Structural Still Results in Overtopping I-17

Site Number 3	
Structural (+'s)	**Non Structural (+'s)**
• 56 Parcels Positively Affected with Improved Access • Restore Old Roadbed - Expand Riparian Area • Better Experience for Trail Users along Skunk Creek • Lower Cost to Provide Area Access Compared to Bridge at Site 8 • Cost Sharing partners • Improves Traffic Safety • Reduces Floodplain • Some Community Acceptance	• Development Guidelines Maintain Flows at Current Levels • FRP Would Allow Road Closures in Timely Fashion
Structural (-'s)	**Non Structural (-'s)**
• Full Parcel Takes (Up to 5)	

Site Number 4	
Structural (+'s)	**Non Structural (+'s)**
• Multi Use Opportunities For Horse Arena, Trail, Neighborhood Parks • Mitigates Roadway Flooding	• Partial Solution with Buyout Program • Buyout Less Expensive than Structural • Little Environmental Impacts • Extending Floodplain Delineation Study Upstream Would Provide Additional Regulation in Currently Unmapped Area
Structural (-'s)	**Non Structural (-'s)**
• Disruption of Natural Channel Systems • Waters of the US Impacted - Permitting Issues • Public Acceptance Uncertain • Loss of Natural Character of Immediate Area • No One to Maintain Small Parks • Maintenance Costs • Construction Costs • No Cost Sharing Partners • Removing Significant Vegetation	• Displaces Residents • Partial Public Acceptance • District Becomes Owner of Spatially Dispersed Parcels • Doesn't Address Street Flooding

Site Number 5	
Structural (+'s)	**Non Structural (+'s)**
• Removes Parcels from Floodplain & Floodway • Agency Acceptance (MCDOT, ASLD) • Planned 7th St. Improvements by MCDOT to Incorporate Structural Alternative Information into Design • Phased Structural (Prioritize North of Cloud) • Cost Sharing • Improves Public Safety • Multi Use (Trail) Potential	• Buyout is Less Expensive than Structural • FDS May Provide More Detailed Info. For Regulating • FRP - Advance Warning for Interrupted Access on 7th St. & Cloud • No Environmental Impacts • No Maintenance
Structural (-'s)	**Non Structural (-'s)**
• Not Significantly Decreasing Flows South of Cloud Road • Many Full Take Parcels South of Cloud Road • No Partner for Maintenance • Disruption of Natural Channels • Lack of Public Support for Trails in Private Easements	• Buyout Doesn't Address Floodplain Residents with FFE below BFE

Site Number 6	
Structural (+'s)	**Non Structural (+'s)**
• Keep 100-yr Flows Off Carefree Hwy (which is road of regional significance) • Bridge at Apache Rd. Reduces Conflict for Pedestrians Crossing Hwy • Bridge Enhances Animal Migration • Improves Public Safety	• Development Guidelines Maintain Flows at Current Levels • FRP to be used for Road Closure
Structural (-'s)	**Non Structural (-'s)**
• Huge Cost • No Agency Acceptance	

Site Number 7	
Structural (+'s)	**Non Structural (+'s)**
• Gets 24th St. Out of Wash • Opportunity to Revegetate/Restore Wash • Cost Share Partners • Agency Acceptance (MCDOT, ASLD) • Public Safety/Emergency Access	• FRP used for Road Closure
Structural (-'s)	**Non Structural (-'s)**
• Impacts Stock Tank • Archeological Site West of Current Alignment	

Site Number 8	
Structural (+'s)	**Non Structural (+'s)**
• MCDOT Bridge Section Supports Structural Alternative - Need 100 Year Design • Stronger Justification than Site 3 based on MCDOT Closure Data & Traffic Counts • Agency Acceptance • Fire Station on East Side & Need to Service West in Anthem • Cost Share Partner (MCDOT) • Some Community Acceptance • Reduced Bridge Length Could Reduce Costs • Opens Up Travel Corridors for Animals • Trail Planned for Wash • Bike Path on Desert Hills Drive • Long Term - Could be Future Tie into a TI at I-17	
Structural (-'s)	**Non Structural (-'s)**
• Higher Cost than Site 3	

Site Number 9	
Structural (+'s)	**Non Structural (+'s)**
• Public Safety - Major Emergency Access Route • Enhances Wildlife Movement • Opportunity for Trail • Reduces Maintenance Costs, Improves Ease of Maintenance	
Structural (-'s)	**Non Structural (-'s)**
• No Agency Acceptance (MCDOT)	

Site Number 10	
Structural (+'s)	**Non Structural (+'s)**
• Some Agency Acceptance • Public Safety Critical - Gateway Access to Cline Creek basin • Environmental Impact Minimal	• FRP to be used for Road Closure
Structural (-'s)	**Non Structural (-'s)**
• No District Cost Share	• Road Not Protected

Site Number 11	
Structural (+'s)	**Non Structural (+'s)**
• Opening Up Approaches to Bridge will Make It Function Better & Reduce Maintenance Costs. • 64 Parcels Positively Impacted • Improving Bridge Approaches Keeps Bridge from being Inundated, and Enhances Public Safety • Removes 30-40 from Floodplain • Potential Cost Share w/MCDOT Due to Road Inundation West of the bridge at ≤ 10 yr Event	• Development Guidelines Would Maintain Current Flows • FRP Would Allow Time to Close Roads • Flood Delineation Study Needed in Overflow Area to Provide Better Information for Regulating • No Environmental Impacts • Lower Cost
Structural (-'s)	**Non Structural (-'s)**
• Impact to High Quality Habitat - Pygmy Owl, Desert Tortoise • Over 1 Mile of Man Made Features Impacting Visual Character • Vegetation Removal Under Footprint • High Cost (Maintenance & Construction) • Liability Associated with Long Term Viability of Structures • Number of Area Residents Impacted by Loss of Natural Character	• Doesn't solve roadway overflow situation • Doesn't solve bridge maintenance situation

APPENDIX D

Recommended Alternative Evaluation Summary

Site Number 1			
Structural Alt.	**Implementation / Timeframe**	**Non Structural Alt.**	**Implementation / Timeframe**
- Channel w/ Drop Structure	By Others (COP) - No FCDMC Participation Long Term	- Dev. Guidelines	
- 35th Ave. Bridge		- Flood Resp. Plan	
- Levee As Needed	By Others (COP) - No FCDMC Participation Long Term	- Flood Delin. Study	
		- Floodway Home	

No Action	Implementation / Timeframe

Site Number 2			
Structural Alt.	**Implementation / Timeframe**	**Non Structural Alt.**	**Implementation / Timeframe**
- Soil Cement Levee		- Dev. Guidelines	Maintain Flows at Current Levels Short Term
- Concrete Levee		- Flood Resp. Plan	Emergency Barricading
- Levee	Cost Share Partners (ADOT,COP,CAP) IGA Specific Conditions Long Term	- Flood Delin. Study	COP Regulate with Best Info Available (FLO-2D model results) Short Term
		- Floodway Home	

No Action	Implementation / Timeframe

Site Number 3			
Structural Alt.	**Implementation / Timeframe**	**Non Structural Alt.**	**Implementation / Timeframe**
- ROW Acq.		- Dev. Guidelines	
- Road Abandon		- Flood Resp. Plan	Emergency Barricading
- Road Const.		- Flood Delin. Study	
		- Floodway Home	

No Action	Implementation / Timeframe
- Current Roadway Alignment Maintained	Bridge at Site 8 Solves the Same Problem Immediate

Site Number 4			
Structural Alt.	**Implementation / Timeframe**	**Non Structural Alt.**	**Implementation / Timeframe**
- Roadside Channels/Culverts		- Dev. Guidelines	
- Basins	Environmental Impacts Costs too Much	- Flood Resp. Plan	Emergency Barricading
- Drainage Channels		- Flood Delin. Study	New FDS Needed Between 11th & 7th Ave. Regulate Currently Unmapped Area Long Term
		- Floodway Home	Buyout Structure No. 40, 41, 47, 48 & 46 Solves Most Severe Problems

No Action	Implementation / Timeframe

Site Number 5			
Structural Alt.	**Implementation / Timeframe**	**Non Structural Alt.**	**Implementation / Timeframe**
- Roadside Channels/Culverts	7th St. & Cloud Road Improvements by Others (MCDOT) Long Term	- Dev. Guidelines	Maintain Current Flow Levels Short Term
- Drainage Channel	Yes North of Cloud by Others (ASLD) No South of Cloud	- Flood Resp. Plan	Emergency Barricading Direct Calls to Residents (FP + FW)
- Basin	Yes With/By Others North of Cloud (ASLD, MCDOT) Long Term	- Flood Delin. Study	Restudy After FW Buyout for Impacts to FP Homes Long Term
Individual Home Floodproofing/Flood Protection/		- Floodway Home	FW Buyout South of Cloud Rd. Buyout Structure No. 37, 5 & 27
		No Action	**Implementation / Timeframe**

Site Number 6			
Structural Alt.	**Implementation / Timeframe**	**Non Structural Alt.**	**Implementation / Timeframe**
- Roadside Channels/Culverts		- Dev. Guidelines	Maintain Flows at Current Levels Short Term
- Drainage Culverts		- Flood Resp. Plan	Emergency Barricading
- Bridge		- Flood Delin. Study	N/A
		- Floodway Home	N/A

No Action	**Implementation / Timeframe**
- No drainage improvements to Carefree Highway	No Upsizing of Desert Lake Wash Crossing Handle Apache Wash Crossing By Adjusting New 24th St. Alignment Grades Immediate

Site Number 7			
Structural Alt.	**Implementation / Timeframe**	**Non Structural Alt.**	**Implementation / Timeframe**
- ROW Acquisition	By Others - ASLD Process Long Term	- Dev. Guidelines	
- Road Abandon	By Others - ASLD/MCDOT	- Flood Resp. Plan	Emergency Barricading
- Road Const.	By Others - ASLD/MCDOT Long Term	- Flood Delin. Study	
		- Floodway Home	

No Action	Implementation / Timeframe

Site Number 8			
Structural Alt.	**Implementation / Timeframe**	**Non Structural Alt.**	**Implementation / Timeframe**
- ROW Acquisition	By Others (MCDOT) Long Term	- Dev. Guidelines	N/A
- Bridge 100 YR	By Others (MCDOT) Fire Station - Homeland Security Fund?	- Flood Resp. Plan	Emergency Barricading
- Roadway Improvements	By Others (MCDOT) Long Term	- Flood Delin. Study	N/A
		- Floodway Home	

No Action	Implementation / Timeframe

Site Number 9			
Structural Alt.	**Implementation / Timeframe**	**Non Structural Alt.**	**Implementation / Timeframe**
- ROW Acquisition	By Others (MCDOT) Short Term	- Dev. Guidelines	
- Bridge	By Others (MCDOT)	- Flood Resp. Plan	Emergency Barricading
- Channel Imp.	By Others (MCDOT) Long Term	- Flood Delin. Study	
		- Floodway Home	

No Action	Implementation / Timeframe

Site Number 10			
Structural Alt.	**Implementation / Timeframe**	**Non Structural Alt.**	**Implementation / Timeframe**
- Channel Protection	Implemented by Others (MCDOT) Long Term	- Dev. Guidelines	N/A
		- Flood Resp. Plan	Emergency Barricading
		- Flood Delin. Study	N/A
		- Floodway Home	N/A

No Action	Implementation / Timeframe

Site Number 11			
Structural Alt.	**Implementation / Timeframe**	**Non Structural Alt.**	**Implementation / Timeframe**
- Channel Imp.	Pending review of FLO-2D information and design modification Long Term	- Dev. Guidelines	Maintain Flows at Current Levels Short Term
- ROW Acq.		- Flood Resp. Plan	Improve Public Safety
- Levees	Pending review of FLO-2D information and design modification Long Term	- Flood Delin. Study	
		- Floodway Home	

No Action	Implementation / Timeframe

Flood Control District of Maricopa County

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

CL Williams
Consulting Engineers

Logan Simpson
Design Inc.

Stantec

RBF
CONSULTING